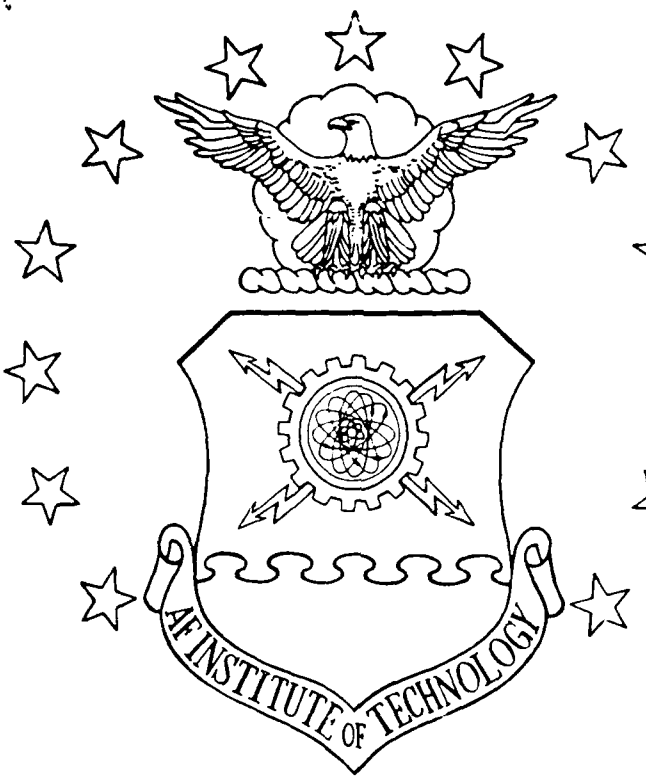

A STUDY OF THE ROLE OF RISK IN THE MANAGEMENT OF AIR FORCE ACQUISITION PROGRAMS

THESIS

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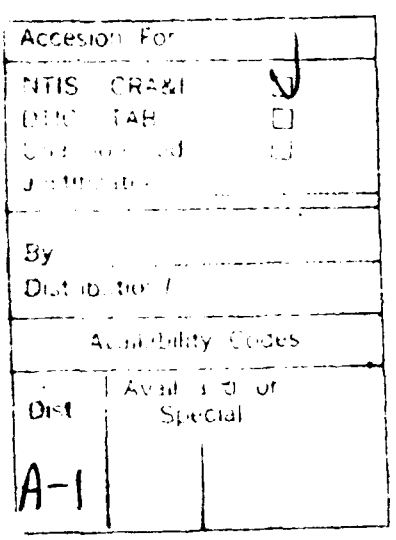

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Presented to the Faculty of the School of Systems and Logistics of the Air Force Institute of Technology Air University In Partial Fulfillment of the Requirements for the Degree of Master of Science in Systems Management

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Mark F. Schenning

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Abstract

The objective of this study was to determine how and to what degree Air Force program managers evaluated the risks associated with the various program decisions in which risk assessments are mandated by federal and defense regulations or directives.

This preliminary study took responses from a series of interviews with program managers to assess the program managers' knowledge of risk and risk assessments, how they usually performed risk assessments, why they performed risk assessments, and if any relationships existed between individual backgrounds and risk taking behaviors.

The research found that although the program managers in this study were all involved with risk assessments and analyses, they did not appear to be properly educated in the areas of risk and risk assessment. The managers were, however, interested in learning more about the concept of risk and strongly suggested the addition of formal coursework in the area of risk management.

This study also showed that differences are likely to exist between program managers possessing technical degrees (engineering, basic sciences, etc.) and those not possessing technical degrees with respect to how cost and technical risk are evaluated in various program phases. To get a more

in-depth understanding of the relationship of risk to Air Force weapon systems acquisition, it is important to understand why these differences exist.

Consequently, it is recommended that further research be carried out to more precisely measure this difference in risk taking tendencies.

A STUDY OF THE ROLE OF RISK IN THE MANAGEMENT OF AIR FORCE ACQUISITION PROGRAMS

I. Introduction

The defense acquisition business is an inherently risky business for both the military and the civilian contractors who produce the defense weapon systems. Threats are sometimes difficult to predict, and methods for countering these threats are often state-of-the-art or beyond. Some of these defense acquisition programs are

> designed to achieve performance levels never before realized, using many components and some materials never before used in military applications. (16:10)

As a consequence of working in this risky environment, the acquisition manager must make decisions considering the "unpredictability of technical performance, development time, and cost" (16:10).

In an article outlining what makes a good project manager, Thornberry and Weintraub state that one of the four primary work skills of a project manager is decision making (33:75).

> Project Managers were good decision makers and **risk takers**. They had to gather data, refine the problem, deduce causation, develop alternatives and analyze the costs/benefits of each alternative (33:75) (emphasis added)

It is well known that Air Force acquisition program managers take risks in almost every decision they make;

there are risks associated with such program issues as cost, schedule, technical performance, supportability, programmatics, etc. Decisions must be made to address these risk related issues.

Air Force Risk Decision Areas

A prime example of an acquisition program manager's decisions involving risk is the set of decisions associated with contractor source selection. The Air Force regulation outlining the procedures and policies involved in the source selection process, AFR 70-15, specifically calls for a risk assessment as part of the proposal evaluation and source selection decision (7:16).

> The risks which must be assessed are those associated with cost, schedule, and performance or technical aspects of the program. Risks may be inherent in a program by virtue of the program objectives relative to the state of the art. Risks may occur as a result of a particular technical approach, manufacturing plan, the selection of certain materials, processes, equipment, etc., or as a result of the cost, schedule and economic impacts associated with these approaches. (7:17)

The program office is responsible for preparing a preliminary risk assessment for the Source Selection Evaluation Board prior to the contractor's proposal submissions. This is done so that the board can compare the contractors' critical program risk areas with those identified by the government (7:16).

Department of Defense Directive 5000.1, Major and Non-Major Defense Acquisition Programs, outlines the policies

and procedures for the acquisition of defense systems, and risk is specifically addressed in the directive on two occasions. First, risk is called out as a decision factor when determining whether or not a program is to be designated a major program. A program that is determined to have a high degree of development risk can be designated a major program, and, hence, require Secretary of Defense or Secretary of the Air Force milestone review and approval (9:2). The second area in which risk is addressed by DoD Directive 5000.1 is in the development of a program's acquisition strategy. The directive addresses risk in acquisition strategy with the following:

> Commensurate with risk, such approaches as developing separate alternatives in high-risk areas; using early funding to design-in reliability and support characteristics; reducing lead time through concurrency; using competitive prototyping of critical components; combining acquisition phases and making use of evolutionary acquisition procedures; and combining developmental and operational test and evaluation shall be considered and adopted when appropriate. (9:5)

The program manager must make decisions on whether or not to incorporate any of the above strategies to reduce the technological, schedule and cost risks of a program (9:5).

Related to the acquisition strategy is the acquisition plan. Part 7 of the Federal Acquisition Regulation outlines the necessary components of the acquisition plan, and part of the plan is a discussion of risk (24:300). The acquisition plan for a major system must do the following:

> Discuss technical, cost, and schedule risks and describe what efforts are planned or underway to reduce risk and the consequences of failure to achieve goals. If concurrency of development and production is planned, discuss its effects on cost and schedule risks. (24:300)

The above statement highlights the fact that all aspects of risk (cost, schedule, and technical performance) must be analyzed together because they may have effects on each other. In other words, if technical risk is reduced through concurrency of development, will that drive up cost or lengthen the schedule? This planning phase of the acquisition cycle is where most of the risk analysis and related decisions are made. The program manager must answer questions like,

> Is the system mature enough to impose specifications and standards without losing a better solution? Have I enough information to streamline testing requirements? Are risks low enough to impose concurrency of test and evaluation? (29:37)

Another area of the acquisition plan in which the program manager must make a decision involving risk is in the selection of a contract type. The program manager can choose to have a firm-fixed-price type of contract in which the **contractor** assumes all financial risks. The program manager can go to the other end of the spectrum and choose to have a cost-plus-fixed-fee type contract in which the **government** assumes all financial risks, or he or she can choose a shared risk type of incentivized contract somewhere between the two extremes (34). This decision is normally

based on the level of definition of the program. If the program requirements are well established with a package of specifications, drawings, and other data which dictate what is to be produced, a firm-fixed-price production type contract is used. Conversely, if requirements are not well defined, a cost type development contract is normally used (17:61).

Test and evaluation (T&E) is one other major area in which the acquisition manager addresses program risk. One of the four primary purposes of a T&E program is "to identify, assess, and reduce the acquisition risks" (8:2). The acquisition manager addresses the risk aspects of the program when developing the program Test and Evaluation Master Plan (8:2).

The Air Force acquisition program manager makes program decisions based on an organizational goal of weapon system deployment and an overall goal of maintaining "an effective and ready fighting force" (4:14). Above are just a few examples of where a program manager is specifically directed to address risk in the acquisition cycle. The program manager must weigh alternatives against each other when making program decisions; the level of risk associated with each alternative is a major factor in this weighing process.

Role of the Program Manager

J. Ronald Fox and James L. Field discuss the role of the program manager with the following:

> As the key figures in the acquisition process, program managers must oversee the efforts of their military services to acquire, deploy or operate, and support major weapon systems of proven capability within approved schedules and budgets. To fulfill these objectives, they are expected to:
>
> 1. establish firm and realistic system and equipment specifications;
> 2. define organizational relationships and responsibilities;
> 3. **identify high-risk areas**; (emphasis added)
> 4. select the best technical approaches;
> 5. explore schedule, cost, and technical performance trade-off decisions;
> 6. establish firm and realistic schedules and cost estimates;
> 7. formulate realistic logistics support and operational concepts; and
> 8. lay the groundwork for contracting for the program. (16:21)

Risk is specifically addressed by Fox and Field in item 3 above, but in order to analyze specifications, evaluate technical approaches, make trade-offs, and make schedule and budget decisions, the program manager must know the elements of risk associated with each and make that a factor in his or her decision process (16:21).

DoD Directive 4245.7, the defense guide for transitioning defense programs from development to production, requires that "elements of program risk shall be identified and assessed throughout the acquisition cycle" (10:2). A manual accompanying this directive analyzes the acquisition process and the possible elements of risk at all phases of development. The manual is a useful guide for identifying risks, but it provides no means of assessing or quantifying the risks. The manual divides the acquisition

process into phases of design, test, and production, and provides templates of these phases. These templates address activities under each phase. For example, under the test template, eight sub-categories of testing are identified, and possible risky areas are identified under each (10:4-2).

Even though methods for analyzing potential risk areas are in existence, there are no **standardized** methods for performing risk assessments within the Department of Defense. The method used is left to the discretion of the individual program manager. Also, there is no standard way of quantifying risk. Air Force Regulation 70-15 defines risk as being "high," "moderate," or "low," but this is not considered a standard to be used for all types of risk assessments (7:16).

Problem Statement

Acquisition managers are required by regulation to manage risk and to perform risk assessments and analyses when making decisions for various aspects of their programs. However, clear and explicit guidance as to how to perform these risk-related tasks is not provided. Without knowledge as to "how" to manage and assess risk, it is likely that inconsistent management of risk will occur.

Objective

The overall objective of this research is to determine how and to what degree Air Force program managers evaluate

the risk associated with the various program decisions listed below:

1. Contractor source selection.
2. Preparing the Acquisition Strategy.
3. Preparing an Acquisition Plan risk assessment for the Procuring Contracting Officer (PCO).
4. Determining the type of contract to be used.
5. Determining Test and Evaluation objectives.
6. Other program specific areas.

Investigative Questions

To meet the overall objective, the following investigative questions must be answered.

1. How do program managers view the concept of risk?
2. How much risk do they feel is present in each of the program management decision areas outlined above, and what kinds of risks are they?
3. What means do program managers use to evaluate (formally or informally, quantitatively or qualitatively) risk in each area?
4. What circumstances lead them to evaluate risk in these ways?
5. Do correlations exist between risk taking tendencies and the following independent variables:

a. Academic Degree?
b. Types of Work Experiences?
c. Age?
d. Marital Status?

In question 5 above, the variable "academic degree" referred to whether or not the program manager held a technical degree. A technical degree was defined to be any scientifically based degree such as engineering or chemistry.

The variable "types of work experiences" actually referred to two variables in the correlation analysis. The first of these two was whether or not the program manager had any operational experience. Operational experience was defined to be any experience outside of the Air Force Systems Command systems acquisition environment which dealt with the day-to-day missions of the Air Force. Examples of operational experience included such jobs as pilot, navigator, missile officer, maintenance officer, etc. The second of the work experience variables was whether or not the program manager had worked at a base other than Wright-Patterson Air Force Base. The other two variables used in the correlation analysis, "age" and "marital status," were self explanatory.

Rationale

There is a basic problem with making decisions involving risk in the systems acquisition environment.

> Risk management for the DoD system acquisition process is not an exact science. There is no common or standard DoD sanctioned practice, technique, or procedure for identifying, assessing and managing risk. Furthermore, there is no universally accepted definition of risk. (20:192)

Because there is no standardized, quantitative or qualitative way of measuring program risk in the acquisition environment, the risk assessments and analyses associated with Air Force programs are highly subjective and based mainly on the individual risk taking tendencies of the program manager. Other research has shown that people do not evaluate risks in the same manner, leading to a variety of decisions when faced with risk and uncertainty (12:3). Understanding the risk taking tendencies of program managers can serve as a starting point for developing more objective criteria for evaluating and assessing the risks associated with the many decisions common to program management. With the recent strong interest in risk assessment in the acquisition community, developing a greater understanding of risk in that environment should be useful to the program manager.

Summary

The purpose of this introductory chapter was to acquaint the reader with some of the issues involving risk and the Air Force acquisition program manager. In addition, it presented the problem statement, the objective of this research, and the rationale for this research. Chapter II is a review of the literature concerning risk, uncertainty, and how they are addressed in the Air Force acquisition process. Chapter III is a discussion of the methodology used to carry out this research. Chapter IV is a summary of

the results of the research, and the final chapter contains conclusions and recommendations for any possible solutions and for further studies in the area of risk and acquisition management.

II. Literature Review

Overview

The concept of risk has been widely studied and documented, and opinions vary widely as to what exactly constitutes risk. These semantic differences are addressed in this review of the literature. First, risk is defined in a general sense. This includes a discussion on how risk relates with utility theory and what sets risk apart from "uncertainty."

Following the general discussion of risk is a more specific discussion on how managers view risk and how that risk can be measured. Finally, the literature review focuses on risk in the realm of the Department of Defense and the Air Force systems acquisition process. This includes a review of several models, techniques, and other tools available to the program manager for managing risk. It should be noted that although these tools exist, no guidance was found to mandate their use.

Definition of Risk

Webster's Contemporary American Dictionary defines risk as "the possibility of suffering harm or loss; danger" (35:608). MacCrimmon and Wehrung break this definition down further into three parts.

> First, it is necessary that there be a potential *loss* of some amount. Second, there must be a *chance* of loss. A sure loss is not a risk. Third, the notion "to *expose*" means that a

> decision maker can take actions that can increase the magnitude or chance of loss. (26:9)

MacCrimmon and Wehrung also point out two types of losses, the first being something that will make one "worse off" than he or she is presently, the second being something that is not as good as something else that could have been obtained (26:10).

Fischoff and others, distinguish a risk problem decision from an ordinary decision in that risk problems include some threat to life or health among its consequences (15:2). For the purposes of this research, that threat to life or health is expanded to a threat involving any type of loss.

Grose states that risk has a large number of components.

> A totally inclusive definition of risk includes hazards, dangers, potential for loss, the degree or probability of a specific exposure for loss as well as the liability to injury, damage, loss, or pain. It encompasses jeopardy or the exposure to extreme danger for any situation. Events with both chance and voluntary provocation are included. Loss potential due to risk also embraces rational behavior, irrational behavior, natural phenomena, and any other potential for realizing unwanted, negative consequences of any event. (18:24)

This definition is simplified by Grose to be "the likelihood of injury, harm, damage or loss multiplied by its potential magnitude" (18:25). The term "likelihood" implies some sort of probability of occurrence. According to Peter Sprent,

any study of risk or risk management must involve the use of statistical methods to assess these probabilities.

> It calls for an understanding of how to collect and interpret relevant factual evidence. Equally importantly, it demands an appreciation of the psychology of human reaction to uncertainty and risk; this is linked to both how we perceive danger and to our ability to interpret correctly all relevant factual information. (31:5)

Byrne and Cadman also emphasize the importance of gathering necessary and relevant information when assessing risks and making decisions. They underscore the need for sifting through given information:

> In one way or another, objectively or subjectively, the developer or decision-maker has to sort out or analyze the information that he is given and then make the best decision he can. Because these decisions have to be made very largely on the basis of estimates or expectations of the future, the developer has to contend with uncertainty. (3:24)

The Defense Systems Management College (DSMC) guide to risk management defines risk as "the probability of an undesirable event occurring *and* the significance of the consequence of the occurrence" (6:3-1). This DSMC definition is similar to Grose's in that both emphasize the magnitude or significance of the consequence. The relationship between the probability of occurrence and the severity of the consequence and how they combine to produce a level of risk is illustrated in Figure 1.

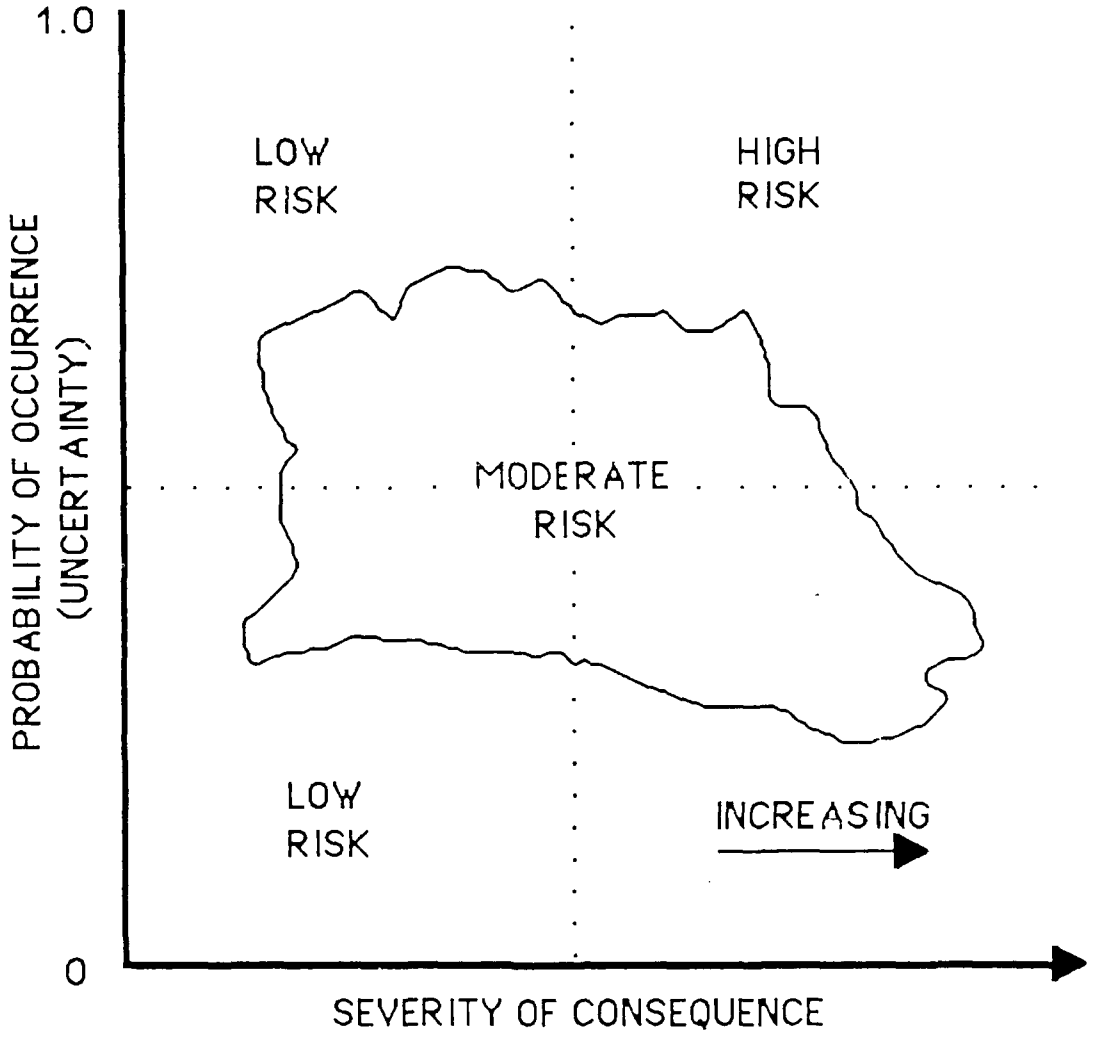

Figure 1. Concept of Risk
(Reprinted from 6:3-2)

Figure 1 shows four quadrants. Three of the four quadrants contain a known level of risk. The low probability/low severity quadrant is an area of low risk. The high probability/low severity quadrant is generally low risk, and the high probability/high severity quadrant is an area of high risk.

The low probability/high severity quadrant is the area in which program manager individual interpretation plays a major role in determining the risk level. If the consequence is extremely severe, the risk may be high even with an extremely low probability of occurrence (6:3-2). An example of this type of high risk would be the acquisition of pressure suits for the space shuttle astronauts. The pressure seals in the suits must be as close to 100% reliable as possible. Any failure is unacceptable, and, hence, the item could be considered high risk.

The DSMC guide also notes that overall program risk is dependent upon the risks associated with each component of the system. A large number of moderate risk components can result in a program with an overall high risk rating. Also, a program with only a small number of high risk items may result in a program with an overall low risk rating. The program manager must use some model or tool to make this overall program assessment. Some of these models and tools are discussed later in this literature review (6:3-2).

The Relationship of Risk and Utility Theory

Byrne and Cadman believe that an individual's perspective of risk and risk preference is best described through the use of a utility curve. An individual can be shown to be a risk-taker, a risk-seeker, or a risk-neutral person depending on the shape of the curve (15:54). Management scientists use utility theory to determine these risk taking tendencies. Three concepts used to determine these tendencies are, Expected Value, Certainty Equivalent, and Risk Premium (36:582).

An individual's risk taking tendencies can best be understood by considering the following example.

Suppose an individual is given a choice of two outcomes with equal probability (a 50-50 chance). The first is that he or she gains $30,000; the second is that he or she loses $10,000. The **expected value** is equal to the sum of each outcome multiplied by its respective probability of occurrence. In this case:

Expected Value = (30,000)*(.5) + (-10,000)*(.5) = $10,000

The **certainty equivalent** is the value at which the decision maker is indifferent between the above choice of outcomes and receiving a certain outcome. For example, he or she may be indifferent between losing $3400 for sure and deciding between gaining $30,000 or losing $10,000. In this case:

Certainty Equivalent = -$3400

Finally, **risk premium** is the difference between the expected value and the certainty equivalent. In this case:

Risk Premium = 10,000 - (-3400) = $13,400

This individual "values (the choice) at $13,400 less than its expected value, because (he or she) does not like the large degree of uncertainty associated with the reward yielded by (the choice)" (36:582). This positive result implies risk-averse behavior. A risk premium equal to zero implies risk-neutral behavior, and a negative risk premium implies risk-taking behavior (36:582).

A study by Kahneman and Tversky tested utility theory to evaluate people's risk taking tendencies. In addition to the process described above, they studied the domain in which the decisions were made. The domain of a decision was either positive or negative. Their results showed that individuals tended to be risk averse in the positive domain. A gain of $3000 for sure was preferred to a gain of $4000 with an 80% probability (expected value of 3000 preferred over expected value of 3200). However, these same individuals were risk seeking in the negative domain. A loss of $4000 with an 80% probability was preferred to a loss of $3000 for sure (expected value of -3200 preferred over expected value of -3000). These results are inconsistent with pure utility theory which would suggest that the domain would make no difference. The primary reason for this difference, they suggest, is that people tend to overweight certainty (23:269-275).

The Relationship of Risk and Uncertainty

Byrne and Cadman relate risk and uncertainty with the following:

> ...uncertainty is taken to be anything that is not known about the outcome of a venture at the time when the decision is made. In contrast, risk is taken to be the measurement of a loss, identified as a possible outcome of the decision. (15:10)

The relationship of risk and uncertainty was addressed by Kahan in the context of decision making.

> Consequences result as a function of our choice. If the decision maker's choice uniquely determines the consequences, then we speak of decision making under **certainty**. If, on the other hand, consequences occur, given a choice, with a known (or estimable) probability, then we speak of decision making under **risk**. Finally, if we don't (or can't) know the probabilities, then we speak of decision making under **uncertainty**. (22:1) (emphasis added)

The concept of uncertainty can be thought of as a continuum ranging from complete certainty to complete uncertainty. According to Adams and Martin, the level of uncertainty is inversely related to the amount of information available to the decision maker. With total information, there is no uncertainty present, and a decision is made with a known outcome (no risk). Risk enters the uncertainty continuum when the decision maker has partial information about a negative outcome. This partial information is the likelihood or probability of an outcome. The "risk" is the possible undesired outcome and its associated probability of occurrence. As the level of uncertainty increases along the continuum, a region of

complete uncertainty is encountered where no information is available to the decision maker, and all decisions are made with no known or estimable outcome probabilities (1:36).

Management's View of Risk

The literature suggests that managers view risk with a less precise view than those of the definitions discussed above. March and Shapira suggest three differences. First, most managers do not feel that the positive consequences of a decision are an important aspect of risk. In other words, a decision which involves only positive outcomes with their respective probabilities does not involve risk. Risk is strictly associated with negative outcomes. Second, many managers see uncertainty as a factor in risk. In other words, risk is not uniquely made up of probablistic outcomes. Thirdly, "managers show little desire to reduce risk to a single quantifiable construct" (27:1407). Many managers resist using available tools to quantify the factors which enter into a risk decision or assessment. Managers tend to stress the importance of such things as personal judgment and expertise as part of their risk calculations. Managers need to have a "gut feel" for the riskiness of a situation rather than simply rely on computer generated data based on some specific set of algorithms (27:1407).

Why Do Managers Take Risk?

March and Shapira point out three reasons managers take risks.

> 1. Risk is essential to success in decision making.
> 2. Risk taking is an essential component of the managerial role.
> 3. Managers recognize emotional pleasures and pains. (27:1409)

Their research found that managers feel that in order to be successful in business, a manager must take risks when making decisions, and this relates to his managerial role. They also suggest that successes are more satisfying when a chance is taken, and these chances cannot be taken without risk. The thrill of making a decision under risk keeps the job challenging and interesting (27:1409).

Risk Measurement

To measure risk propensity among managers in their studies, MacCrimmon and Wehrung used two types of risk measures:

1. Primary Measures. These consisted of standardized situations and allowed for meaningful comparison. Examples of these included investment gambles for both the business and the individual and pre-defined risky office situations such as a lawsuit, a customer threat, or a union dispute. These measures permitted analysis of general risk taking tendencies (26:183-185,207).

2. Secondary Measures. These consisted of Attitudes and Natural Situations which were observed. These were used to evaluate whether or not any individual acted in a real-life situation as he or she would in a standardized situation. From these observations, inferences were made (26:183-185,207).

These authors and researchers have shed light upon some general aspects of risk and uncertainty. Their different perspectives indicate the great variability associated with how to manage risk in general. The next section describes how these general risk issues have been addressed in the acquisition of Department of Defense and Air Force weapon systems.

Risk in Air Force Systems Acquisition

A network analysis manual sums up the origin of risk analysis in defense acquisition programs as follows:

> With the advent of the large cost overruns and schedule slippages experienced on many major development projects in the defense sector of the U.S. economy in the late sixties and early seventies, military managers realized a need for RISK ANALYSIS. (28:2)

Initially, the Army was the lead agency for developing methods for risk analysis. One of these methods was a computerized networking technique called the Venture Evaluation and Review Technique (VERT). What set VERT apart from previous networking techniques was the fact that it could handle extremely complex decision problems in terms of

cost and/or schedule and/or performance rather than simply time alone. Hence, a risk assessment could be performed incorporating all elements of program risk (28:1-3). The Air Force followed suit by establishing their own computerized networking program for analyzing risk. This program, maintained at the Armament Division, Eglin AFB, FL, is called "the RISK model" (5:VI-5).

Because of the increasing level of technological complexity of defense programs and the associated risks involved, Deputy Secretary of Defense Carlucci initiated the Acquisition Improvement Program (AIP) in 1981. One of the initiatives was to increase the awareness of technological risk and the costs involved in performing inadequate risk assessments. This initiative was called "Budgeting for Technological Risk" and called for program managers to allow for an increased management reserve budget to account for possible cost growth due to technological complexity (2:375).

What resulted from the Office of the Secretary of Defense interest in risk assessment was the development of cost/risk assessment concepts based on the Army's Total Risk Assessing Cost Estimate (TRACE) methodology. The TRACE method used a risk factor approach in which components of a program were assigned a factor based on an estimate of their relative risks. These factors were applied to the estimated

cost and resulted in a revised cost estimate known as the TRACE (5:Appendix I-2).

The various methods for performing risk assessments are outlined in the DSMC guide for risk management. Methods that can be used include the following:

1. Expert Interviews.

This involves questioning experts in certain areas about the risk aspects of their specialties (6:5-4).

2. Analogy Comparison/Lessons Learned Studies.

This involves comparing programs with similar past programs and their associated risks (6:5-7). The DSMC guide on risk management states the following:

> ...key insights can be gained concerning the various aspects of a current program's risk, by examining the successes, failures, problems, and solutions of *similar* existing or past programs. (6:5-7)

3. Plan Evaluation.

This involves addressing risk in all program documents relating to planning and ensuring that there are no inconsistencies or contradictions (6:5-12). Examples of these program documents are the following:

- Program Management Plan (PMP)
- Systems Engineering Management Plan (SEMP)
- Acquisition Plan (AP)
- Test and Evaluation Master Plan (TEMP)
- Manufacturing Plan (MP)

- Integrated Logistics Support Plan (ILSP)
- Work Breakdown Structure (WBS) Index and Dictionary
- Specifications and the Specification Tree
- Statements of Work
- Other "Baseline" Documents (6:5-11,5-12)

4. Transition Templates.

This involves planning for risk using the templates found in DoDD 4245.7-M (6:5-19).

> Each template examines an area of risk and then describes methods for avoiding or reducing that risk. Much of the description of the risk and the solution is based on lessons learned from other programs. (6:5-19)

In addition to the qualitatively based methods described above, some mathematical or quantitative tools for performing risk analysis are also described in the DSMC guide. These include the following:

1. Decision Analysis.

This involves choosing among several decision alternatives using probabilities, states of the world, and expected monetary values as inputs and decision criteria (6:5-21,5-22).

2. Cost Estimating Relationships.

This involves using

> an equation to determine an appropriate management reserve or risk funds budget. When using this method, the management reserve funds represent the amount of funding, over and above that determined

> by cost analysis alone, required for work associated with unanticipated risks. (6:5-25)

The equation is based on correlations of costs with certain performance characteristics (6:5-25).

3. Network Analysis.

This involves establishing a critical program path and identifying potential areas of schedule risk (6:5-29).

4. Life Cycle Cost Analysis.

This involves "a series of equations which compute program costs based on product and program information" (6:5-34).

5. Cost Risk/WBS Simulation Model.

This involves the use of computers to simulate what will happen to program costs given the probablistic outcomes of each Work Breakdown Structure cost element (6:5-37).

As previously stated, the objective of this research is to determine how and to what degree Air Force program managers evaluate the risks associated with certain program decisions. The above review of the literature suggests that the tools and methods for risk assessment are available to the program manager. The methodology in the following chapter was designed to determine if, how, and to what extent Air Force program managers at the Aeronautical Systems Division (ASD), Wright-Patterson AFB, Ohio use these tools and methods in managing their programs.

III. Methodology

Overview

This chapter describes the methods used to determine how and to what degree Air Force acquisition program managers evaluate and assess the many risks associated with their programs. Specifically, this research focused on the areas of Air Force program management in which risk assessments, analyses, and evaluations are mandated by regulation or directive. The purpose of this chapter is to present the research population, the methods of data collection and reduction, and any research assumptions or limitations.

The review of the literature concerning risk in Air Force program management revealed several areas in which risks were to be addressed by the program manager throughout the life of the program. For the purposes of this research, the term "program manager" referred to any person in a program office concerned with the day-to-day management aspects of the program. These people could range in rank from the General or Colonel acting as program director to the Second Lieutenant in charge of test planning. Since this definition of a program manager covered such a wide spectrum of personnel, the population in this study was limited to mid-level military and civilian program managers

(Captain through Lieutenant Colonel and civilian grade equivalents).

Population and Sample Description

Population. Because of time, physical, and financial constraints the population of this study was limited to analyzing the risk taking views of mid-level Air Force acquisition program managers at the Aeronautical Systems Division (ASD), Wright-Patterson AFB, OH. Each of the interview subjects carried a primary Air Force Specialty Code (AFSC) of 27XX, Acquisition Manager.

Sample. The sample of interest was drawn from the population of mid-level acquisition managers located at ASD. This sample represented a cross section of program managers from both major and non-major systems at ASD. A major system is defined by DoD Directive 5000.1 to be any program designated so by the Secretary of Defense or any program requiring the following:

> ...total expenditure for research, development, test, and evaluation of more than $200 million (based on Fiscal Year 1980 constant dollars) or an eventual total expenditure for procurement of more than $1 billion (based on Fiscal Year 1980 constant dollars). (9:2)

Emory states that samples can be taken based either on probability techniques or on nonprobability techniques. Probability sampling employs some sort of random sample selection technique. Examples of these are simple random sampling, stratified sampling, cluster sampling, systematic

sampling, and double sampling. Nonprobability sampling, in contrast, uses no random sampling techniques. What this means is that "each member does not have a known nonzero chance of being included" (14:278). Emory suggests that nonprobability sampling is useful in studies that are "looking only for a feel of the range of conditions" (14:279). Emory also points out that nonprobability techniques are advantageous because of reduced cost and time requirements. Because this was an exploratory study looking for a "feel" of the Air Force program manager's view of risk, nonprobability sampling was the technique used. This was an acceptable method given that care was taken to control the sampling process. Emory states "Carefully controlled nonprobability sampling often seems to give acceptable results" (14:279).

The method of nonprobability sampling used in this study was called purposive sampling. A purposive sample is one which draws subjects based on certain pre-specified criteria. The form of purposive sampling most appropriate for this study was judgment sampling. "Judgment sampling occurs when one handpicks sample members to conform to some criterion" (14:280). The members chosen for this study were chosen based on the criterion that they performed, were involved with, or were familiar with some sort of risk analysis or assessment in the management of their Air Force acquisition programs. Emory states, "When used in the early

stages of an exploratory study, a judgment sample is quite appropriate" (14:280).

The nonprobability sampling technique used in this study produced results in which generalizations could be made about population parameters.

Data Collection Technique

The primary method for data collection was a series of 25 personal interviews with Air Force program managers. As stated above, the source was a representative sample of managers from the Air Force Systems Command product division located at Wright-Patterson AFB. Parten states some advantages of the personal interview:

> The personal interview usually yields a high percentage of returns, for most people are willing to cooperate.
>
> The information secured is likely to be more correct than that secured by other techniques since the interviewer can clear up seemingly inaccurate answers by explaining the questions to the informant.
>
> The interviewer may catch the informant off guard and thus secure more spontaneous reactions than would be the case if a written form were mailed out for the informant to mull over. (30:79-80)

A weakness in this third point above is that little thought may be put into the response to a question. To overcome this weakness, prior to all interviews, interviewees were provided with a summary of questions to be asked during the interview so that some pre-thought could be accomplished concerning the general issues of the interview.

Spontaneous reactions would then still be possible when desirable, but thought out responses could also be obtained when appropriate. Interviews were conducted to determine each individual subject's views on risk and uncertainty, their risk taking tendencies in the program management arena, and their methods of managing and assessing risk as program managers.

The interview guide consisted of questions concerning the specific Air Force risk assessment areas outlined in Chapter I. Those were:

1. Contractor Source Selection.
2. Preparing the Acquisition Strategy.
3. Preparing an Acquisition Plan risk assessment for the Procuring Contracting Officer (PCO).
4. Determining the type of contract to be used.
5. Determining Test and Evaluation objectives.
6. Other Program Specific Areas.

The guide primarily consisted of open-ended questions. Labaw discusses the two types of open-ended questions. One type of open-ended question allows the respondent to freely answer the question in any way he or she chooses. The second type of open-ended question contains precoded answer categories. Both of these types of questions were used in the construction of the interview guide. An example of a completely open-ended question used in this research was a question asking for a definition of the term risk. Labaw

states the following concerning the use of open-ended questions which concern complex issues:

> Open-ended questions provide absolutely indispensable insight into how respondents interpret complex but apparently single-issue questions. (25:134)

How one would define risk is a prime example of a complex but apparently single-issue question. Although risk is a seemingly single issue, many aspects of risk exist which can complicate the task of defining the term.

One intent of the open-ended question format was to allow for the freedom of respondents to address the aspects of risk in such a way that perceptions about risk might be categorized according to risk type (cost, schedule, or performance). Respondents were asked to provide an assessment of what they perceived their own risk taking tendencies to be. Questions were asked to ascertain the relative importance of risk in the management of a program. Along with these open-ended questions were a series of closed questions which ask about specific involvement in various program management areas. Questions were also asked to determine the interview subjects' personal, educational, and work backgrounds to see if they correlated in any way with their risk taking tendencies (25:131).

Emory states that testing of the interview guide is essential to ensure that the interviewer is able to gather the information he or she desires. He suggests bringing

colleagues into the testing process and performing a "test-revise-retest" cycle of tests and updates (14:206-207).

This interview guide was tested through a series of five test interviews with selected Air Force Institute of Technology School of Systems and Logistics students and faculty. These students and faculty members all had former program management experience and were all familiar with the concept of risk and the ways it influences the Air Force acquisition process. Revisions were then made based on recommendations from the interviewees.

Interview Guide

The interview guide (Appendix A) contained two sections. The first section addressed various personal characteristics of the interview subject. Data in this section included personal data: rank or grade, age, sex, marital status, and number of children. This section also asked for the subject's educational history and work history. The data from this first section was used to determine whether or not any correlations existed between a subject's attitudes toward risk and any of the five program management areas outlined earlier.

The second section of the interview guide contained a series of 13 questions concerning risk and its relationship to the Air Force acquisition environment. Most of the questions were open-ended, allowing for a broad range of

responses. Four of the questions were closed questions, requiring a specific yes/no or numerical response.

The following section describes the methods of analysis used in reducing the data obtained from the series of interviews. A description of the analysis techniques used for each of the interview guide questions and how each question applies to the objectives of this research is discussed.

Data Analysis and Reduction

The data obtained through the 25 interviews were analyzed to answer the investigative questions outlined in Chapter I. Questions 1, 9, 11, and 12 of the interview guide (Appendix A) were asked to answer the first investigative question concerning how managers view the concept of risk. How did they define risk? How did they view the risk assessments that were being performed? How did they view themselves as far as risk was concerned? How did they view their own knowledge of risk?

Responses to question 1 were categorized by whether or not the interview subjects mentioned the consequence element of risk, the probability element of risk, both elements, or neither element in their definitions. Category totals and percentages were calculated and graphed to get a feel for how well the definition of the concept of risk was understood.

Question 9 asked the respondents to rate how thoroughly they felt risk assessments and analyses were performed at ASD. A zero to one hundred scale was provided, and the respondents were asked to indicate at what point on that scale the answer to the question should fall. The mean and variance were then calculated to get a feel for how ASD viewed the thoroughness of risk assessments and analyses in general.

Question 11 asked the interview subjects to describe themselves as far as risk was concerned while on the job. They were given three categories, risk taker, risk neutral, and risk avoiding. Explanations of the terms risk taker, risk neutral, and risk avoiding were given to interview subjects who indicated that they were unfamiliar with the terms. The explanations used were the explanations of these terms described in Chapter II. The responses were categorized, and totals were calculated and graphed. The graphs were created to display possible trends in responses. Also, a correlation matrix was created using the data from question 11 and the personal data from the first section of the interview guide. A correlation matrix is "the tabular arrangement of all the correlation coefficients that can be calculated from all the possible pairings" of the data (21:223). Using the STORM software package for quantitative decision support, values of r, the correlation coefficient, were calculated, and the correlation matrix was produced

(13:281). The correlation matrix compared the responses of the program managers as risk takers with the following independent variables:

1. Academic Degree.
2. Types of Work Experences.
3. Age Greater than 30.
4. Marital Status.

The data above are contained in Appendix C.

The correlation matrix can be found in Appendix D. Any relationships between variables are discussed in Chapter IV.

Question 12 asked the interview subjects about how comfortable they were with their knowledge of risk and risk assessments. Responses were categorized by yes, no, and unsure, and totals were calculated and graphed. As with the question 11 graph, the question 12 graph was used to display any trends in responses.

Questions 6 and 7 were asked to answer the second investigative question concerning the amount and types of risk program managers felt were present in each of the five program management areas outlined previously. Question 6 simply asked the respondents to indicate whether or not they had been involved with any decision making involving risk in any of those areas. These results were tabulated, totaled, and graphed.

For question 7, interview subjects were asked to rate the cost, schedule, and technical performance risks

associated with each of the five areas discussed above in question 6. A five point Likert scale, composed of five levels of importance, ranging from "not at all" to "extremely" important, was used with this question. Subjects were provided with a matrix of all 15 individual categories and rated each using the scale. Mean values for each of the 15 categories were calculated and tabulated.

Data from question 7 were also used to answer the fifth investigative question concerning possible correlations between risk taking tendencies and the personal data from the first section of the interview guide. Correlation matrices were created using these data. Three correlation matrices were produced. Each correlation matrix compared the responses in a specific risk category (cost, schedule, or technical performance) with the following indicator variables:

1. Academic Degree.
2. Types of Work Experiences.
3. Age Greater than 30.
4. Marital Status.

The correlation matrices can be found in Appendix E. Correlation coefficients ≥ 0.4 were analyzed, and these are discussed in Chapter IV.

Questions 2 and 3 of the interview guide were asked to answer the third investigative question which asked about the methods ASD program managers used to evaluate risk.

Question 2 asked how program managers usually evaluated risk, and question 3 asked if they used any other methods than those discussed in question 2.

Responses to question 2 were categorized in two ways. First, they were categorized as to whether the risk assessments were formal versus informal. Second, they were categorized as to whether the risk assessments were quantitative versus qualitative. These categories were totaled and graphed.

Statistical tests were run on these data to determine if program managers tended to perform informal rather than formal or qualitative rather than quantitative risk assessments. A binomial test was used because the data satisfied the requirements of independent Bernoulli trials. Those assumptions were the following:

1. The outcomes of each trial can be classified as a "success" or a "failure."
2. The probability of a success, denoted by p, remains constant from trial to trial.
3. The n trials are independent. (19:15)

Responses to the question were dichotomous and could be categorized as "successes," informal and qualitative, or "failures," formal and quantitative. There was no reason to believe that p varied from trial to trial. Finally, each of the n trials was independent.

The null hypothesis of each binomial test was that the probability of a success was equal to the probability of a

failure (p = 0.50). In other words, it was initially assumed that the probability of performing an informal assessment was equal to the probability of performing a formal assessment. Similarly, the probability of performing a qualitative assessment was equal to the probability of performing a quantitative assessment.

The alternative hypothesis of each test was that p was greater than 0.5 and that ASD program managers were more likely to perform informal and qualitative risk assessments than formal and quantitative risk assessments respectively.

The test statistic used for this particular test was B, the number of successes (informal or qualitative risk assessments). The null hypothesis would be rejected in favor of the alternative hypothesis if B were greater than or equal to b, the upper tail percentile point (number of successes) of the binomial distribution for n = 25 and p = 0.50. The value of b was obtained from an upper tail probability table for binomial disributions (19:263).

An alternative test statistic was P, the probability that B, the number of successes, occurred strictly by chance using the binomial distribution for n = 25 and p = 0.50. This value was also obtained from an upper tail probability table for binomial distributions (19:263). If this probability was less than 0.05, the null hypothesis would be rejected in favor of the alternative hypothesis which was that p was greater than 0.50.

Tests were run using both of the above test statistics and results are provided in Chapter IV. In addition to the above binomial tests, an estimation of the true value of *p* (95% confidence) was obtained from a binomial confidence limit table (32:454).

The fourth investigative question was asked to determine why program managers performed risk assessments in any particular manner. Question 10 of the interview guide addressed this investigative question directly. A discussion of the responses can be found in Chapter IV.

Questions 4, 5, and 13 of the interview guide addressed the interview subjects' backgrounds on where risk assessment methods were learned, what quantitative tools they were familiar with, and what guidance on risk assessment they were familiar with. Discussions of their responses, including graphical summaries are contained in Chapter IV.

Limitations

The sample was taken strictly from the population of program managers located at the program offices of ASD, and should not be generalized to represent the population of program managers Air Force wide. Also, as stated earlier, the sample was not a completely random sample of program managers at ASD. The judgement, purposive sample may be limited in its generalizability and should only be used to

obtain a "feel" for ASD program managers' views of risk and risk assessments.

The following chapter provides an analysis of the data obtained through the series of 25 interviews discussed earlier in this chapter.

IV. Data Summary and Analysis

This chapter provides an analysis of the data collected for this research. A descriptive summary of the responses to each interview question is provided. This summary includes results from any statistical tests performed on the responses. Conclusions and recommendations are contained in Chapter V.

Interview Procedures

Interviews were conducted with mid-level Air Force acquisition program managers in accordance with the research design outlined in Chapter III. Twenty-five interviews were conducted. Interviewees were selected using a purposive sample of program management personnel. Twenty-one military and four civilian personnel were included in the sample, and the sample included personnel from Air Force programs at various stages of development. The programs ranged from relatively simple, low cost programs like the Laser Eye Protection program being developed at the Life Support System Program Office (SPO), to technically complex, multi-million dollar programs like the C-17 development program. The sample was considered representative of the personnel working the broad spectrum of systems being developed at the Aeronautical Systems Division (ASD).

The program management personnel who participated in this research as interview subjects appeared to have put a

great deal of time and thought into their responses and were all highly cooperative and accommodating for the interviews. Each interview subject was asked to review the interview guide prior to the interview. Some subjects had prepared written responses to some of the questions after reviewing the interview guide. The interviews lasted an average of approximately 25 minutes. A detailed summary of responses to selected questions can be found in Appendix B.

Interview Questions

Question 1. HOW WOULD YOU DESCRIBE THE CONCEPT OF RISK?

This question was asked to get a feel for how program managers viewed the concept of risk. How was the program manager's view of risk different from or like the views brought forth in the literature on risk and risk assessment?

Responses to this question, as expected, were highly variable. As stated in Chapter II, the DSMC definition of risk involves both the probability *and* the significance of the consequence of an undesirable event. Twelve of 25 responses mentioned the consequence of a decision in their description of risk. However, of these 12, only seven subjects suggested that the **significance** of the consequence was a determinant of the level of risk. Ten of 25 responses suggested that risk involved the chance, likelihood, or

probability of occurrence of an undesirable outcome. Five of the responses included both the probability of occurrence and the consequence of an event. Eight responses said nothing about probabilities of occurrence or consequences.

Some of these responses stressed the uncertainty associated with a situation as the element of risk. This view is represented in the following response:

> Risk is the uncertainty induced by schedule or budget problems caused by unrealistic expectations. Risk arises when proposed schedules are unrealistic. Our risks are generally low because we don't really push the state-of-the-art.

Certain subjects felt the term risk was vague and ambiguous. They had a difficult time coming up with a definition. These definitions seemed to describe where risk was addressed, but not what it actually was. This is shown in the following definition of risk:

> The risk of a program depends on the technical aspects of the program, the dollars spent, and the schedule impacts of certain decisions. Risk is subjective The user of the weapon system drives the requirements and the subsequent risks.

Both of the above responses discuss possible causes of risk. Unrealistic schedules, technically complex requirements, and limited funding **cause** the level of risk to increase. Though these responses indicate possible causes of risk, they do not actually define what **risk** is.

Others were more familiar with risk, but still had problems providing a clear, succinct definition. This is shown in the definition below:

> Risk is the degree at which you'll expect to accomplish something within constraints (money, time, resources, technology). Risk is derived from uncertainty. At work, the degree of consequence is the driver.

The responses to question 1 support the literature in that there is no standardized DoD definition of risk present in the responses of these program managers. The data suggests that risk is viewed in a number of ways with varying degrees of specificity as far as probabilities and significance of consequences are concerned. A summary of which concepts were mentioned by whom in defining risk is shown in Table 1. The data also indicate that the focus of many program managers is on the causes of risk. This may be advantageous in that program managers might be better able to reduce risk, if they are aware of the causes.

Question 2. DESCRIBE HOW YOU USUALLY EVALUATE RISK. WHAT PROCESS OR STEPS DO YOU GO THROUGH? CAN YOU GIVE AN EXAMPLE?

This question was asked to determine how program managers evaluate risk. Do they use some sort of formal process? Do they lean toward qualitative methods versus quantitative methods?

Table 2 is a summary of responses categorizing the risk assessment processes of ASD program managers to be formal or informal and quantitative or qualitative. For the purposes

Table 1

Risk Definition Summary (Question 1)

Interview Number	(A) Consequence	(B) Consequence Significance	(C) Probability	Both A&C
1	X		X	X
2				
3				
4	X	X	X	X
5			X	
6			X	
7	X	X	X	X
8			X	
9	X			
10	X			
11	X	X		
12				
13			X	
14			X	
15				
16				
17	X	X	X	X
18	X	X		
19				
20				
21	X			
22	X			
23	X	X	X	X
24				
25	X	X		
Totals	12 (48%)	7 (28%)	10 (40%)	5 (20%)

of this research, a formal assessment was defined to be any standard process a program manager went through to assess risk, be it quantitative or qualitative. This process was the same process he or she went through each time he or she

Table 2

Risk Assessment Type Summary (Question 2)

Interview Number	Formal	Informal	Qualitative	Quantitative
1		X	X	
2	X		X	
3		X	X	
4		X	X	
5		X	X	
6		X	X	
7		X	X	
8	X			X
9		X	X	
10		X	X	
11		X	X	
12		X	X	
13		X	X	
14		X		X
15		X	X	
16		X	X	
17		X	X	
18	X			X
19		X	X	
20		X	X	
21		X	X	
22		X	X	
23		X	X	
24		X	X	
25		X	X	
Totals	3 (12%)	22 (88%)	22 (88%)	3 (12%)

performed a risk assessment. Conversely, informal risk assessments had no specific structure or method.

A quantitative risk assessment was defined to be any process in which some kind of numerical process was used to generate an answer which described the risk of a situation.

The quantitative assessment was generally a more objective assessment. A qualitative assessment was classified as any non-numerically based assessment and was generally more subjective.

An overwhelming majority, 22 of 25 (88%), of interview subjects performed informal, qualitative risk assessments. For each interview subject, a risk assessment consisted of an information gathering exercise from which the risk assessment was drawn. Seventeen of 25 responses (68%) mentioned that they would gather information by seeking advice from government experts when making a risk assessment. Ten of 25 subjects (40%) said that they relied on their own past experience when performing a risk assessment. Other sources of information were historical (similar) programs, lessons learned files, and contractor supplied information. Several respondents mentioned the politics involved with performing risk assessments. For some, these political pressures proved to be quite high, as with the following response:

> Political influences are very strong and can cause a legitimate risk assessment to be thrown out the window so that a more favorable *assessment* can be briefed up the chain.

Table 2 also suggests that the interviewees may have perceived the terms "informal" and "qualitative" in a similar way. Likewise, the terms "formal" and "quantitative" may have been perceived as being similar Of

the 25 responses, 23 were paired in this way (all but Interview Numbers 2 and 14).

Binomial tests of these data verify the fact that ASD program managers are more likely to perform informal, qualitative risk assessments than formal, quantitative risk assessments. The binomial tests performed on the data show two things to support the above conclusion. First, the number of "successes" or informal, qualitative risk assessments that would suggest an equal likelihood (p = 0.50) of formal/informal or quantitative/qualitative assessments should be close to 13. Since B = 22, the data suggests that p is actually much greater than 0.50. Secondly, from a table of upper tail probabilities for binomial distributions, the probability, P, that 22 of 25 persons would do informal, qualitative risk assessments given an equal chance of doing formal or informal and quantitative or qualitative assessments is $\approx$ 0.0001 (19:263). Again, this provides strong evidence that p is actually much greater than 0.50. A 95% confidence interval on the true value of p was obtained from a binomial confidence limit table and verifies that p is actually greater than 0.50 (32:454). The lower and upper bounds respectively of the true value of p are 0.6876 and 0.9745 ($0.6876 < p < 0.9745$). These binomial tests are described in detail in Chapter III, and a summary of the results is contained in Table 3.

Table 3

Binomial Test Results

Informal vs Formal and Qualitative vs Quantitative

Null Hypothesis	Alternative Hypothesis
Ho: $p = 0.50$	Ha: $p > 0.50$

Test Statistic: B (Number of Informal or Qualitative Assessments)

Rejection Region: Reject Ho if $B \geq b$

Where: b (The upper tail percentile point of the binomial distribution for n=25 and p=.5)

Results: (For Both Tests)
b = 13
B = 22
B > b

Therefore: Reject Ho, and $p > 0.50$.

Alternative Test:

Test Statistic: P (Probability that B, the number of successes, occurred strictly by chance for n=25 and p=.5)

Rejection Region: Reject Ho if $P \leq 0.05$

Results: (For Both Tests)
P = 0.0001
P < 0.05

Therefore: Reject Ho, and $p > 0.50$.

From the binomial confidence limit table (95% confidence):

p Lower = 0.6876 p Upper = 0.9745

$(0.6876 < p < 0.9745)$

Question 3. DO YOU USE ANY OTHER METHODS TO EVALUATE RISK? IF SO, WHICH ONES?

Since question 2 asked how acquisition program managers **usually** evaluated risk, question 3 was included to determine what other methods, if any, the subjects used when performing a risk assessment. In response to this question, the interview subjects seemed to be inclined to discuss whether or not they had used any of the quantitative tools mentioned in question 5 of the interview guide. Fifteen of 25 respondents said that they used no other methods to evaluate risk than those discussed in response to question 2. Five of the subjects mentioned using a network analysis on their program, but only one of those five specifically addressed schedule **risks** with the analysis. Two subjects mentioned using life cycle cost models, and one person mentioned using Milestone or Gantt type charts to address schedule risk. These responses indicate that very few explicit methods or techniques are used by ASD program managers to evaluate risk.

Question 4. WHERE DID YOU LEARN THE METHODS DESCRIBED ABOVE?

This question was asked to determine the source of each program manager's knowledge of risk and risk assessments.

Because some respondents determined that they had no real method of performing a risk assessment, they felt that this question was not applicable. Seventeen of 21 who responded indicated that what they learned about risk assessments was learned on the job or through personal experience. Three subjects indicated that they learned their networking techniques in school. One respondent indicated that the methods were learned from contracting courses and the Federal Acquisition Regulation. These results indicate that risk assessment techniques are not being acquired through formal program management courses.

Question 5. ARE YOU FAMILIAR WITH ANY OF THE FOLLOWING QUANTITATIVE RISK ASSESSMENT TOOLS?

1. EXPECTED VALUE/UTILITY ANALYSIS
2. NETWORK ANALYSIS
3. DECISION TREE ANALYSIS
4. LIFE CYCLE COST MODELS
5. COMPUTER SIMULATION

Question 5 was asked to determine which quantitative risk assessment tools ASD program managers had some familiarity with. The reasoning was that a quantitative risk assessment was not possible without the proper tools and training. Results showed that all interview subjects were familiar with at least one type of network analysis

technique. Twenty of 25 (80%) were familiar with Life Cycle Cost (LCC) models, and a majority were familiar with decision tree analysis (68%). Less than half of the respondents indicated any familiarity with expected value analysis (40%) or computer simulation techniques (36%) (Figure 2). These results indicate that the reason for a lack of quantitative risk assessments is not necessarily a lack of knowledge of risk assessment tools.

Question 6. HAVE YOU BEEN INVOLVED WITH A RISK ASSESSMENT IN MAKING DECISIONS AFFECTING ANY OF THE FOLLOWING AREAS?

1. CONTRACTOR SOURCE SELECTION
2. PREPARING AN ACQUISITION STRATEGY
3. PREPARING AN ACQUISITION PLAN RISK ASSESSMENT FOR THE PROCURING CONTRACTING OFFICER
4. DETERMINING THE TYPE OF CONTRACT TO BE USED
5. DETERMINING TEST & EVALUATION OBJECTIVES
6. OTHER AREAS

Question 6 was the first of two closed type questions which specifically addressed the objective of this research. That objective, as stated in Chapter I, was to determine how and to what degree Air Force program managers at ASD evaluate the risk associated with the program decision areas listed above. This question simply asked whether or not the interview subject had been involved with any decis n making

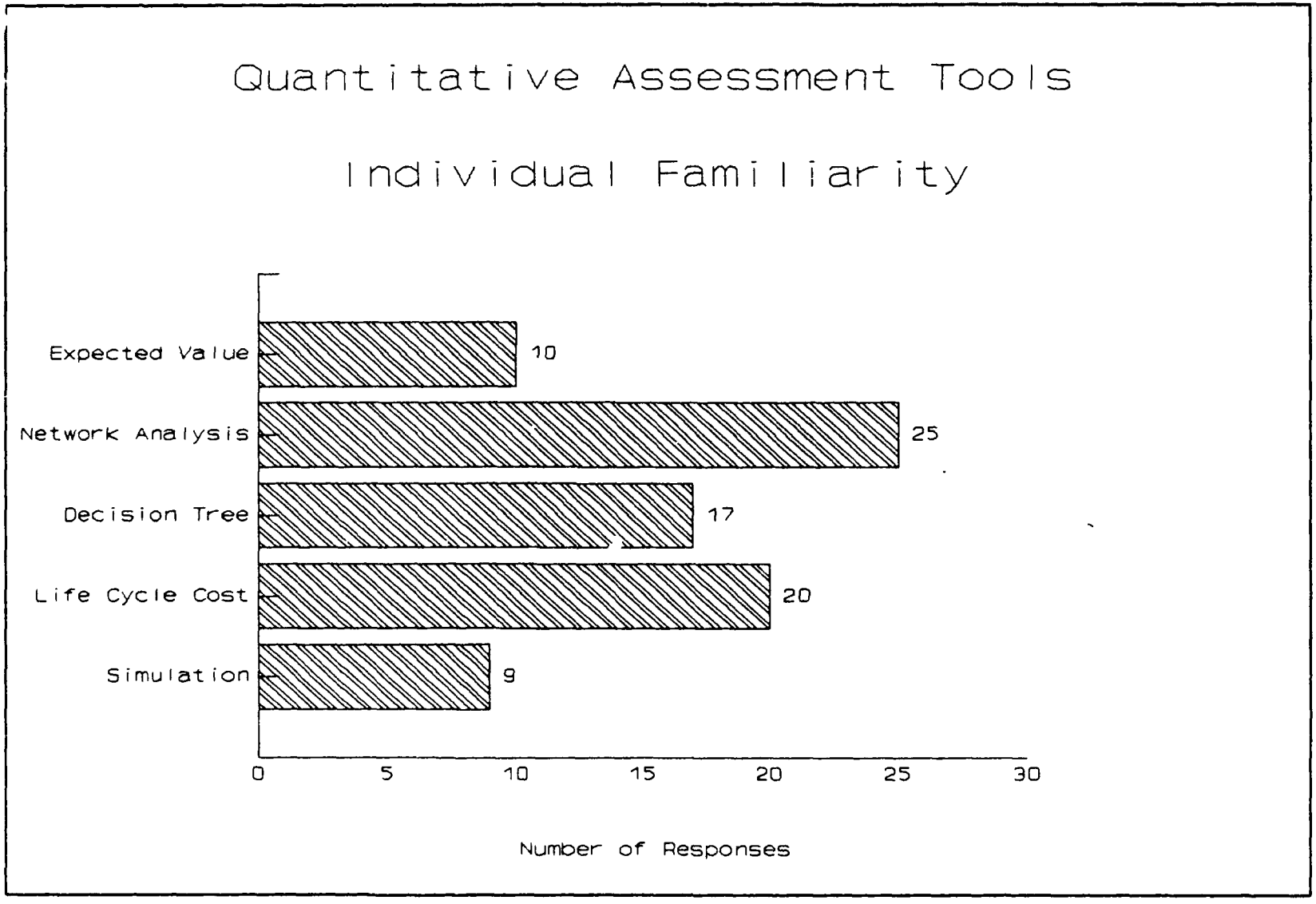

Figure 2. Quantitative Assessment Tools

involving risk in any of the above areas. Results are shown in Table 4 and Figure 3.

Each subject interviewed had been involved in doing a risk assessment for making decisions in at least one of the five areas listed. For each of the five program management areas, a majority of the interview subjects had been involved with making a risk assessment and decision. Contractor Source Selection and Acquisition Strategy preparation were the highest on the list, 80% and 76% involved respectively. These were followed by T&E Objectives - 64%, Contract Type - 60%, and Acquisition Plan preparation - 52%.

These results indicate that risk decisions are being made by the majority of program managers in all of the previously described program management areas. The differences in the above percentages may be caused by the fact that different program managers have had different program management responsibilities. Not all program managers are involved with every phase or aspect of a program. For example, a program manager may have started working with a program after the contract had been awarded. Consequently, he or she was not exposed to the decision process associated with the type of contract awarded. This does not, however, mean that this program manager would not be concerned with the risk aspects of such a decision if he or she were exposed to such a decision later in his or her

Table 4

Risk Assessment Involvement (Question 6)

Interview Subject	Source Selection	Acq Strat	Acq Plan	Contract Type	Test Objectives
1	X	X	X	X	X
2	X				X
3	X	X	X	X	
4	X	X		X	X
5	X				X
6	X				X
7	X	X			X
8	X	X			
9		X	X	X	X
10				X	
11	X				X
12	X	X	X		X
13		X	X	X	X
14	X	X	X	X	X
15	X	X	X	X	X
16	X	X	X	X	
17	X				
18	X	X	X	X	
19	X	X		X	X
20	X	X	X	X	
21	X	X			
22	X	X		X	X
23		X	X	X	X
24	X	X	X	X	
25		X	X		X
Totals	20 (80%)	19 (76%)	13 (52%)	15 (60%)	16 (64%)

career. Question 7 followed up question 6 by asking how important the risks involved with these decisions were to the program managers. The reason the question of risk importance was asked was that the more important a risk was, the more emphasis a program manager would likely place on a particular risk assessment. This would help in determining

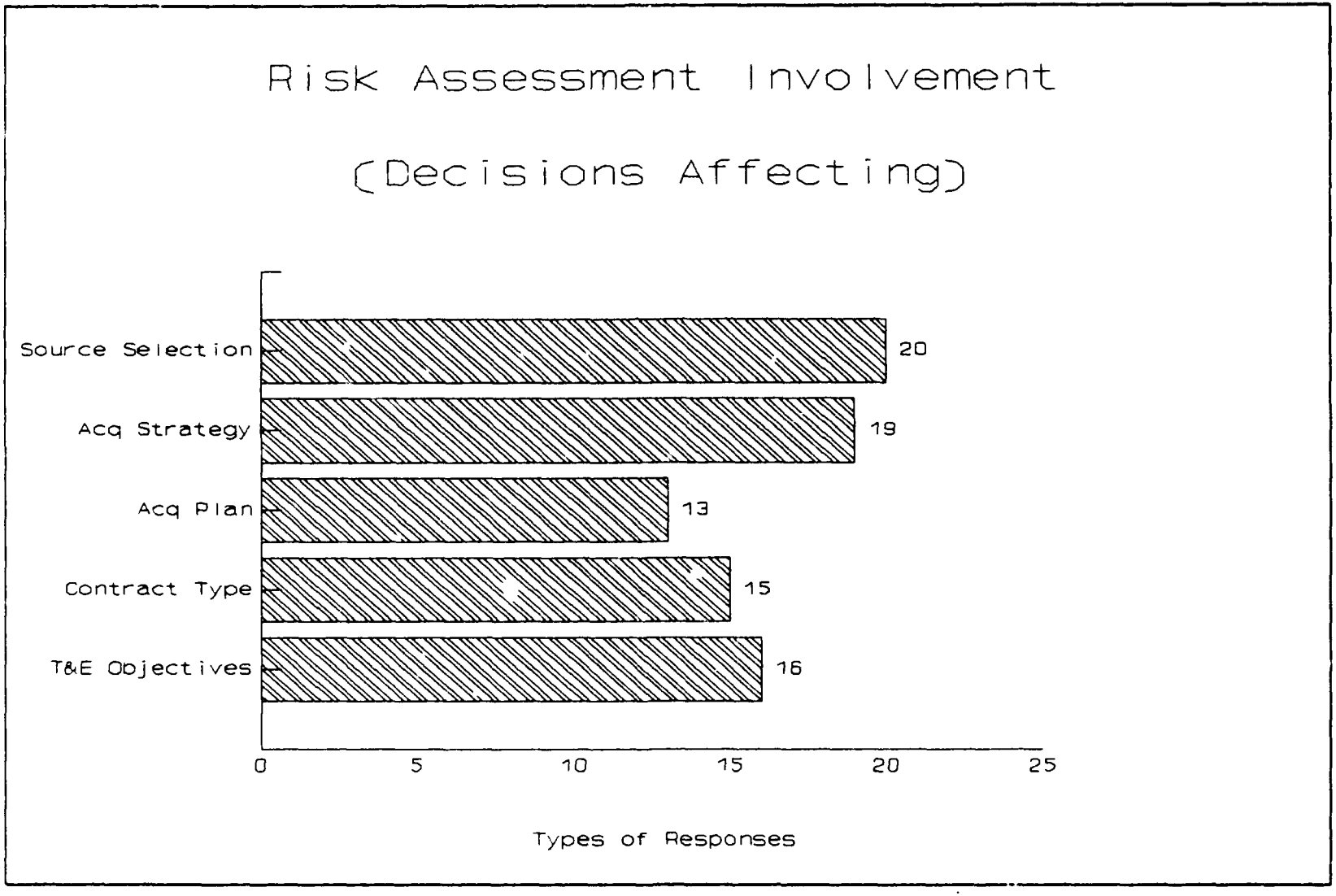

Figure 3. Risk Assessment Involvement

the degree of risk evaluation associated with the program decision areas.

Question 7. PLEASE INDICATE IN THE MATRIX BELOW WHAT TYPES OF RISK (COST, SCHEDULE, PERFORMANCE) WERE ASSOCIATED WITH EACH OF THE ABOVE PROGRAM DECISION AREAS? IN THE SAME BOXES, PLEASE INDICATE THE RELATIVE IMPORTANCE OF EACH OF THESE RISK TYPES USING THE SCALE BELOW (1 THROUGH 5).

Not at all Important	Little Importance	Somewhat Important	Very Important	Extremely Important
1	2	3	4	5

	Cost	Schedule	Technical Performance
Source Selection			
Acquisition Strategy			
Acquisition Plan			
Contract Type			
T&E Objectives			
Other			

Question 7 was asked to determine the types and the relative importance of the risks the program managers felt were present in each of the above areas. A five point Likert scale was used to rate the relative risk importance. Responses to this question and descriptive statistics are assembled in Appendix C. Mean values for each risk category are shown below in Table 5. (Note: The "Other" category is not included in Table 5 because of the small number and variety of responses. However, an overall mean per risk category (columns) and per program management area (rows) is provided.)

Table 5

Risk Importance (Mean Values) (Question 7)

Risk Category / Program Management Area	Cost	Schedule	Tech Perf	Overall Per Area
Source Selection	4.00	3.68	4.45	4.04
Acquisition Strategy	3.64	4.04	3.84	3.84
Acquisition Plan	4.00	4.08	3.71	3.93
Contract Type	4.42	3.46	3.59	3.82
T&E Objectives	3.04	3.70	4.57	3.77
Overall Per Category	3.82	3.79	4 03	

Table 5 shows no consistent pattern of a high or low rating of risk in any particular risk category (cost, schedule, or performance) or for any particular program management decision area. Several of the combinations of risk categories and program management decision areas, however, had logical highs and lows. For example, because cost is the primary focus of most contract types, cost risk was rated highest in the Contract Type area. Schedule risk was rated highest in the two planning areas, development of the Acquisition Strategy and development of the Acquisition Plan. Technical risk was rated highest in the two areas in which system performance is typically stressed, the Source Selection and Test & Evaluation areas.

The highest overall rating of risk importance was with the technical performance risk associated with Test & Evaluation. It follows that the lowest overall rating of risk importance was with the cost risk associated with Test & Evaluation These two facts suggest that program managers may tend to sacrifice cost risks in order to address technical risks during the test and evaluation phase of a program.

It should be noted that subjects were asked to rate the relative risk importance (cost, schedule, and performance) according to each program management decision area (source selection, acquisition strategy, etc.) without regard to other areas, so any comparison among risk areas should be

viewed with caution. In other words, the technical performance risk of Test & Evaluation Objectives is not necessarily the most important of all categories because the technical risk of T&E was not compared with the technical risk of, for example, Source Selection.

Nine of the interview subjects mentioned other areas in which risk assessments were performed. Two subjects mentioned the fact that the budgeting process contained some inherent risk. Risk was associated with the question, "How can you get funding?" Alternative methods for obtaining necessary funding were analyzed, and this analysis included an assessment of the risk associated with each alternative.

Five subjects mentioned the risk associated with system design. Of these five, two mentioned the risk associated with system design trade-offs or trade studies. Two subjects pointed out the risk associated with contract modifications. One subject mentioned the program risk assessments that were done on his program during program design reviews and technical interchange meetings. In each of these cases, risk was a factor in determining system design.

Other program management areas mentioned in which risk assessments were performed were software development, cost estimates, and the decisions associated with providing the defense contractor Government Furnished Equipment (GFE).

A correlation analysis was done on the data from Question 7 and the data collected from the Personal Data section of the interview guide. Correlation matrices of the Cost Risk Importance, Schedule Risk Importance, and Technical Risk Importance are contained in Appendix E. Indicator variables included in each correlation matrix were the following:

1. Academic Degree.
2. Types of Work Experiences.
3. Age Greater than 30.
5. Marital Status.

The correlation analysis was done to determine possible relationships between risk taking tendencies and the above independent variables. All correlations with an absolute value ≥ 0.400 are discussed below.

Three items in the Cost Risk correlation matrix had a correlation coefficient ≥ 0.400. The cost risk associated with Contract Type indicated a direct relationship with age ($r = 0.419$). The subjects over 30 years of age were inclined to indicate a high cost risk importance rating to contract type.

Two items under Test and Evaluation had correlation coefficients ≥ 0.400. An inverse relationship was found to exist between degree type and the cost risk associated with T&E ($r = -0.470$). Non-technical degree holders tended to indicate higher risk ratings associated with cost, and

technical degree holders tended to indicate lower ratings. Finally, a direct relationship was found to exist between having some operational experience and the cost risk associated with T&E ($r = 0.425$). Program managers with some operational experience, as defined in Chapter I, tended to stress the cost risks associated with testing and evaluating weapon systems.

No items were found to have a correlation coefficient ≥ 0.400 in the Schedule Risk correlation matrix, and one item had a correlation coefficient ≥ 0.400 in the Technical Performance Risk correlation matrix. That item indicated an inverse relationship between degree type and the technical risk associated with Source Selection ($r = -0.442$). Non-technical degree holders tended to indicate higher technical perfomance risk ratings for the source selection process.

Question 8. IF RISK ASSESSMENTS WERE DONE IN ANY OF THE ABOVE AREAS, WHAT METHODS WERE USED?

Responses to Question 8 turned out to be no different than the responses provided for Question 2. The reason the question was asked was to determine whether the specific discussions of risk assessment tools and risk assessment areas called to mind any risk assessment methods that may have been used, but were not thought of previously. None of

the interview subjects mentioned any other methods of risk assessment.

Question 9. GENERALLY, ON A SCALE FROM 0 TO 100, HOW THOROUGHLY ARE RISK ASSESSMENTS OR ANALYSES PERFORMED?

Question 9 was asked to get a feel for how ASD program managers viewed the risk assessments and analyses that were being performed at ASD. Specifically, were the manners in which the assessments and analyses were done rigorous and thorough; were they superficial, or were they somewhere in between?

Responses are contained in Appendix F. The mean value of the 25 responses was 50.80. Responses ranged from a minimum of 10 to a maximum of 85. In general, program managers were neutral as to their feelings on the thoroughness of risk assessments and analyses at ASD. Many subjects provided comments along with their numerical responses. Some subjects indicated that a less than rigorous risk assessment was adequate in most cases, and performing an assessment which approached 100 on the scale would provide a benefit not worth the cost. Many interview subjects indicated that the necessary thoroughness of a risk assessment varied with the perceived risk prior to the assessment. If the potential risk was perceived to be high, then a thorough risk assessment would be performed.

Question 10. WHAT IS THE PRIMARY REASON YOU PERFORM RISK ASSESSMENTS THE WAY YOU DO?

Question 10 was asked to determine the circumstances that lead the program managers to evaluate risk in the ways discussed previously. Were the program managers directed by superiors to perform the analyses in a specified manner? Was time a factor in the choice of a risk evaluation method?

Responses to this question varied. Time constraints were the primary reason for nine of the 25 interview subjects. Six of the subjects indicated that they did risk assessments the way they did them because it was the only way they knew how, but it seemed to be adequate. One subject indicated that he did them because of tasking and that the level of risk was usually pre-determined politically.

Seven of the responses addressed the question more from the angle of why risk assessments were done in general, rather than why they performed risk assessments in the way that they did. Two typical responses from these individuals are given below.

1. I do them to answer questions I have about schedule, cost, and performance.

2. To reach the best possible, cost effective, optimum solution to a problem.

Question 11. HOW WOULD YOU DESCRIBE YOURSELF AS FAR AS RISK IS CONCERNED? RISK TAKER? RISK NEUTRAL? RISK AVOIDING? WHY?

Question 11 was asked to get a feel for how ASD program managers viewed themselves as risk takers at work. A summary of responses according to category is shown in Figure 4.

There were some interesting responses to this question. Many subjects indicated that their risk taking tendencies on the job differed from their risk taking tendencies in their personal life. Some interview subjects were willing to take more risks on the job. Conversely, some were willing to take more personal risk. The following responses illustrate these views.

> 1. Personal risk - risk taker. These are known quantities. Professionally - risk averse. I'm dealing with government money. I can't gamble with what doesn't belong to me.
>
> 2. Personally, risk taker. You need to rake risks to get anywhere. On the job, risk neutral because of the environment.
>
> 3. I value my own security. I'll take more risks at work than with my personal life.
>
> 4. Personally, not a risk taker. Professionally, you need to take risks. You have to take risks to get things done. It's very much a function of the environment.

Many of the interview subjects pointed out that risk taking behavior was dependent on the situation or the

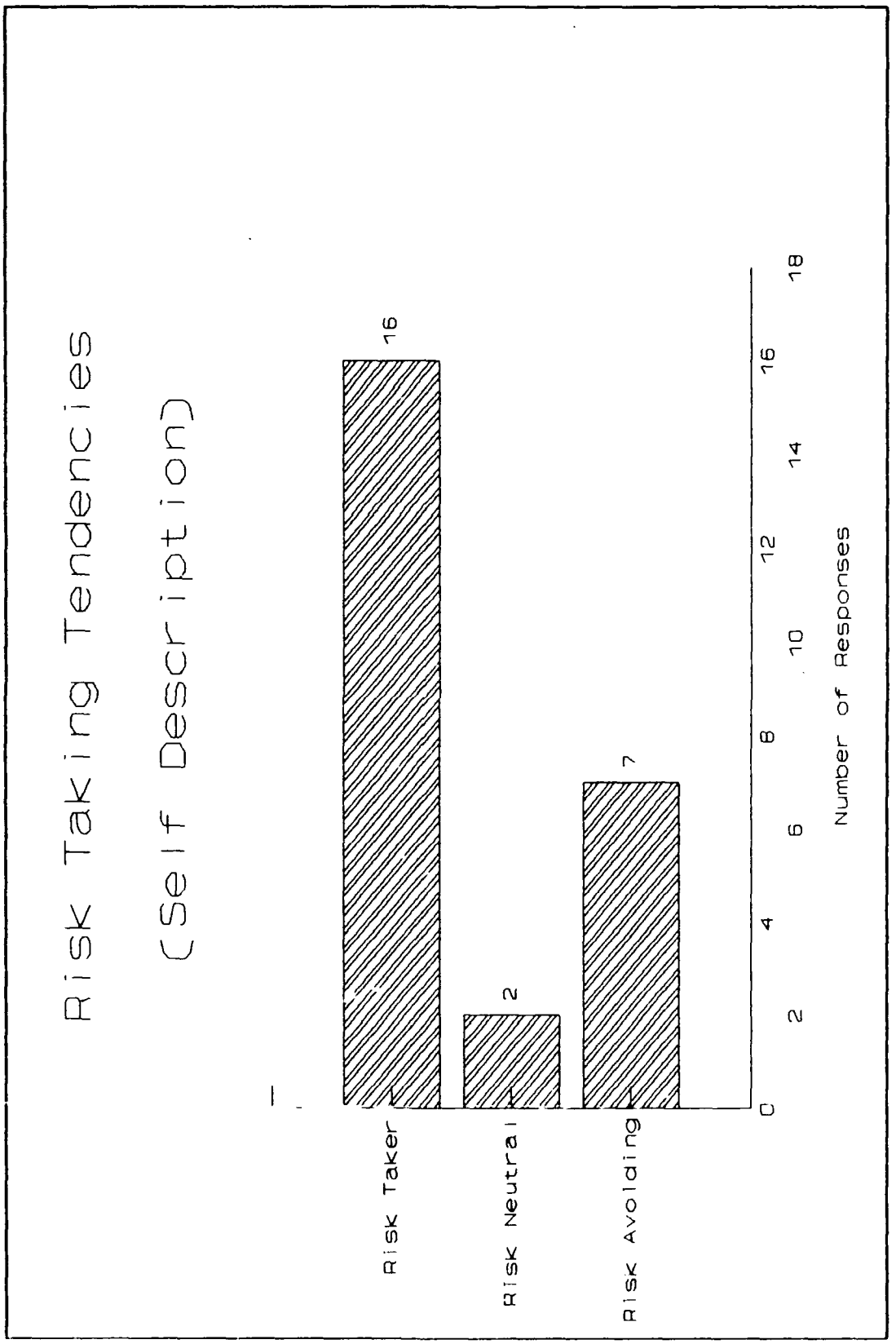

Figure 4. Risk Taking Tendencies

environment. For example, "I take risks when the need is urgent."

There seemed to be a general feeling that in order to get anything accomplished at work, risks had to be taken. This was described by one interview subject as the "nothing ventured, nothing gained" philosophy.

A correlation analysis was done comparing the program managers' responses to question 11 and the indicator variables described above in the analysis of question 7 (Appendix D). The largest value of r, the correlation coefficient, produced by the correlation analysis was 0.250. This was the relationship between possessing a technical degree and describing oneself as a risk taker. Because it is less than the 0.40 used in this study, the reader should decide whether or not this relationship is significant.

Question 12. ARE YOU COMFORTABLE WITH YOUR KNOWLEDGE OF RISK AND RISK ASSESSMENTS? IF NOT, IN WHICH AREAS WOULD YOU LIKE TO INCREASE YOUR KNOWLEDGE?

Question 12 was asked to get a feeling for how content ASD program managers were with their knowledge of the concept of risk and their ability to perform adequate risk assessments. Figure 5 shows how the interview subjects responded to this question.

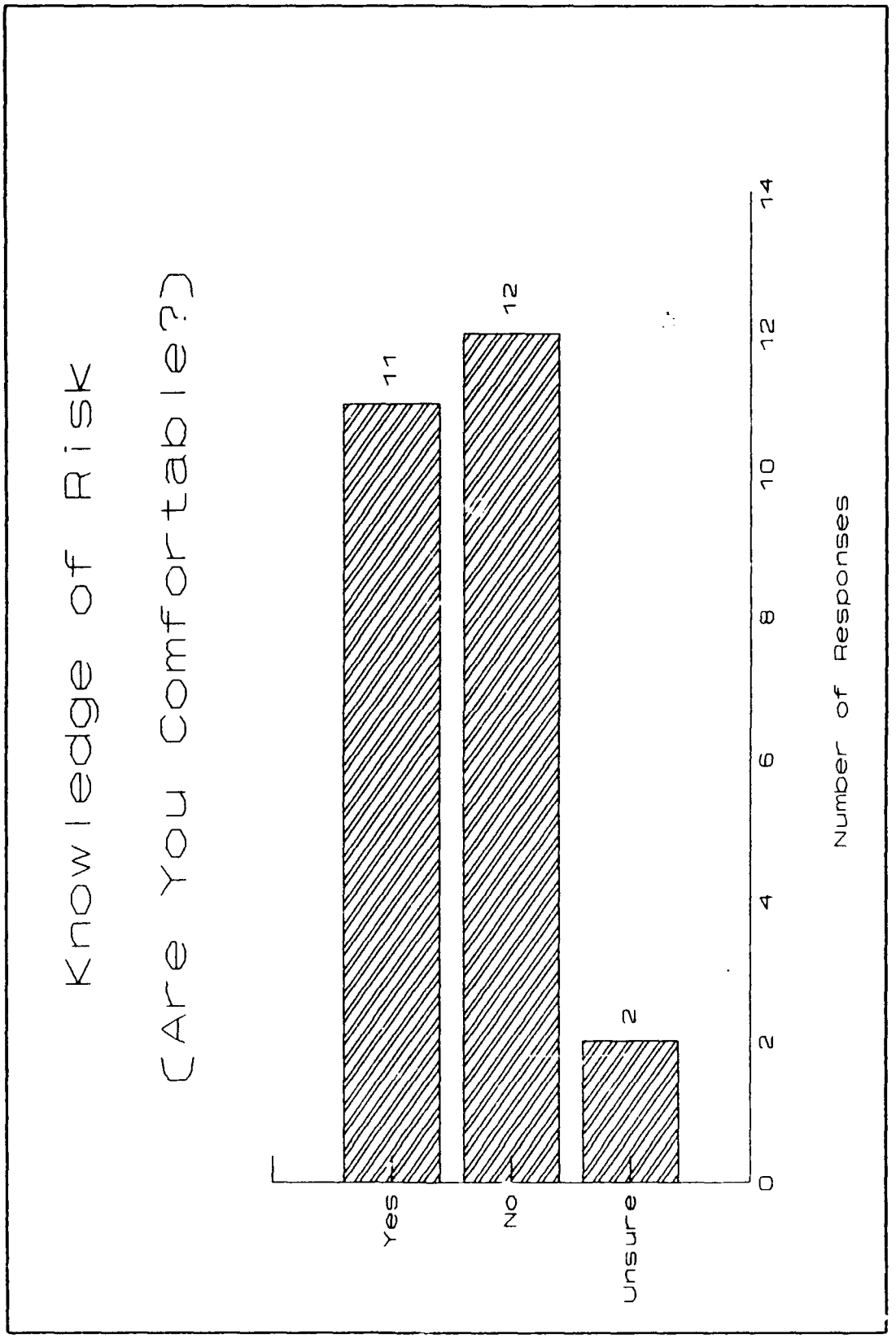

Figure 5. Knowledge of Risk

These results show no general feeling one way or the other as to whether ASD program managers are comfortable with their knowledge of risk and risk assessments. However, the fact that 12 of 25 program managers (48%) said that they were uncomfortable with their knowledge of risk assessments indicates that more education and/or experience may be necessary. In fact, seventeen of 25 responses (68%) indicated a need for additional information about some aspect of risk. Of these 17, seven mentioned that they would like to learn more about some of the quantitative risk assessment tools pointed out in Question 5. Others would like to learn more about some of the formal risk assessment processes (not necessarily quantitative). Still others stated that additional experience would be useful.

Question 13. ARE YOU FAMILIAR WITH ANY DOD GUIDANCE ON RISK ASSESSMENT, ANALYSIS, AND MANAGEMENT? IF SO, WHICH GUIDANCE? WHERE WOULD YOU LIKE TO SEE MORE GUIDANCE?

Question 13 was the last question asked of the interview subjects, and it was asked to determine what Department of Defense sponsored information was in circulation within ASD on risk or any subject relating to risk. Only eight subjects mentioned any knowledge of DoD guidance relating to risk. Two of those eight mentioned knowledge of the Willoughby Templates for identifying risk

areas. These templates are similar to those found in the manual accompanying DoD Directive 4245.7 (Discussed in Chapter II). One subject mentioned knowledge of Military Standard 882B, System Safety Program Requirements. This is a standard which provides guidance on flight safety issues, and it was used by this particular individual during his time at the Air Force Flight Test Center, Edwards Air Force Base, California. One subject mentioned Air Force Systems Command Regulation 70-15, the Air Force guide to contractor source selection. Two of the eight responses indicating knowledge of DoD guidance on risk were not specific as to what guidance they were familiar with.

Eleven of the 25 subjects interviewed said that some kind of course addressing risk assessments in the systems acquisition environment would be useful. Some would like to see specific courses set up to educate systems acquisition personnel on risk analysis and assessments. Others would like to see the addition of risk analysis to the basic systems acquistion formal courses so that they may be educated as to where to look for more specific guidance.

None of the interview subjects were familiar with the Defense Systems Management College manuals on Risk Assessment Techniques or Risk Management Concepts, but most of the subjects indicated an interest in obtaining copies after learning of their existence and contents.

Conclusions based on the results analyzed and discussed in this chapter are brought forth in Chapter V. Along with these conclusions are recommendations for addressing the problems brought forth in this research and recommendations for further research to supplement this study and provide further insight into the role of risk in the Air Force weapon system acquisition process.

V. Conclusions and Recommendations

Introduction

This research project was primarily exploratory in nature. The data collected through personal interviews was studied to determine if generalizations could be made about the "typical" Aeronautical Systems Division program manager and his or her view of risk and its relative importance in the management of Air Force acquisition programs. Possible correlations between individual program manager backgrounds and their views on the concept of risk were studied. The results of this study should serve as a starting point to guide further research in the area of risk in Air Force program management.

Conclusions

The objective of this study was to determine how and to what degree Air Force program managers at the Aeronautical Systems Division evaluated the risk associated with the various program decision areas they faced. These decision areas included the following:

1. Contractor Source Selection.
2. Preparation of the Acquisition Strategy.
3. Preparation of the Acquisition Plan.
4. Determination of the Contract Type.
5. Determination of Test and Evaluation Objectives.
6. Other Program Specific Areas.

To meet that objective, the following five investigative questions had to be answered.

1. How do program managers view the concept of risk?

2. How much risk do they feel is present in each of the program management decision areas outlined above, and what kinds of risks are they?

3. What means do program managers use to evaluate (formally or informally, quantitatively or qualitatively) risk in each area?

4. What circumstances lead them to evaluate risk in these ways?

5. Do correlations exist between risk taking tendencies and the following independent variables:

   a. Academic Degree?

   b. Types of Work Experience?

   c. Age?

   d. Marital Status?

The remainder of this section will discuss the conclusions associated with each of the above investigative questions.

Investigative Question 1: Program Managers View of Risk. Results from this study support the literature in that managers view risk with a less precise view than the classical definitions described in Chapter II. March and Shapira stated that "managers show little desire to reduce risk to a single quantifiable construct," and this was

indeed true in the responses of the program managers at ASD (27:1407). The popularity of the "gut feel" response was strong evidence of this. Few program managers were able to provide a precise definition of risk, and many were only able to describe risky situations and causes of risk.

The ASD program managers in this study did not view the risk assessments being performed at ASD as being extremely thorough, nor did they view them as being simply cursory. The general feeling was that a less than absolutely thorough risk assessment was adequate in most cases.

Generally, ASD program managers viewed themselves as being risk takers, and their responses reflected the feeling brought forth in the literature. That feeling was that risk was essential in order to be successful at work. The correlation analysis showed no strong evidence of a relationship between describing oneself as a risk taker and possessing a technical degree, being married, etc.

Finally, the program managers generally felt that they could use some additional knowledge in the areas of risk and risk assessments or analyses. This would make them more effective as risk managers and in the overall management of their programs.

Overall, program managers viewed risk and risk assessments as being imprecise, but necessary. There was a general feeling that additional knowledge in the areas of risk and risk assessments would be useful.

Investigative Question 2: Risk in Program Decisions. Three basic types of risk are usually addressed in Air Force program management. Those risk types are cost risk, schedule risk, and technical performance risk. Reflecting what the literature suggested, the risk types were not found to be independent of each other by the ASD program managers. In other words, program decisions involving risk affected the perceived risk associated with the cost, schedule, and technical performance aspects of the program. Generally, all risk types for each program management decision area were viewed to be at least "somewhat important." No risk was consistently rated high or low across any particular program management decision area or for any risk type. There were, however, differences in which types of risk were emphasized in various program management decision areas. For example, the technical risk associated with decisions affecting Test and Evaluation was much higher than the cost risk associated with T&E.

Overall, program managers at ASD see all types of risk involved at each stage of the acquisition cycle in the many different decisions that must be made. The data indicate that the level and types of risks emphasized depends on the development stage in which a program lies (planning, contract preparation, test, etc.). Also, the data suggest that program managers may tend to make concessions in one risk type so that risks of another type may be addressed

more thoroughly. Again, this seems to be program phase dependent.

Investigative Question 3: Methods of Risk Assessment. This study investigated the means program managers used to evaluate the risks associated with their programs. Binomial tests of the data showed that ASD program managers tended toward performing informal, qualitative risk assessments rather than formal, quantitative risk assessments. Again, the popularity of the "gut feel" risk assessment supports this conclusion. In addition, the data suggested that there are very few explicit methods or techniques of risk assessment and analysis being used by these program managers.

Investigative Question 4: Reasons for Performing Risk Assessments in a Particular Way. Program managers performed risk assessments in the manners they did because of a number of reasons. The most popular reason was the lack of time necessary for performing more extensive assessments. Surprisingly, only one of the 25 interview subjects mentioned that risk assessments were done in a particular manner because of direction from superiors. This would suggest that the supervisors of these program managers may not be familiar with risk or risk assessment methods. No generalizations or conclusions could be drawn from the data concerning circumstances leading to performing a particular type of risk assessment.

Investigative Question 5: Correlations. The correlation analysis of the data suggested a few relationships that could be significant. The largest correlation was found to exist between the possession of a technical degree and the cost risk associated with Test and Evaluation ($r = -0.470$). This inverse relationship indicated that technical degree holders tended to have a lower rating of cost risk for T&E. This suggests that technical degree holders may be more likely to sacrifice cost risks to address the technical and schedule aspects of Test and Evaluation. Non-technical degree holding managers were relatively more likely to favor the cost risk associated with Test and Evaluation.

Another inverse relationship was found to exist between possessing a technical degree and the technical risk associated with Source Selection ($r = -0.442$). Those program managers with a technical degree tended to indicate lower risk ratings. When combined with the above relationship, the data suggest that technical degree holders may tend toward sacrificing technical risk early in the program and emphasize it later in the program during the testing phase.

Two other possible direct relationships were found to exist. The first of these was between having had some operational experience and the cost risk associated with test and evaluation. Those program managers with prior

experience in operational jobs as discussed in Chapter I, were more likely to rate the cost risk associated with T&E higher than those without operational experience.

The other relationship was that of being over 30 years of age and the cost risk associated with determining the contract type. The older program managers tended to rate that cost risk higher than the younger program managers. The reason for this relationship may be the fact that the Air Force generally applies more responsibility with increasing age. Hence, older program managers may tend to be more concerned with risk in this area because of that increased responsibility.

Overall, the push by senior government and Department of Defense officials to emphasize the importance of risk and risk assessments in the management of Air Force acquisition programs is not being felt by these mid-level acquisition managers at ASD. There was no evidence to indicate that any standardized risk assessment methods were in existence at ASD. There was, however, a general feeling that more education was necessary in the areas of risk and risk assessment and that more standardization could occur if some guidance were available. For the most part, what was known at ASD regarding risk assessments was learned on the job and not through any formal training.

The program managers at ASD were generally familiar with the quantitative tools necessary to perform a quantitative risk assessment, but they were not familiar with how to apply those tools toward a quantitative or formal assessment.

Recommendations

Recommendations to the Aeronautical Systems Division.

The fact that none of the program managers interviewed were familiar with the DSMC guides on risk management and risk assessment techniques seems to provide support that more education is necessary in the areas of risk management, risk analysis, and risk assessment. The program managers at ASD supported the idea of introducing some type of risk education through professional continuing education courses offered at the Air Force Institute of Technology's (AFIT) School of Systems and Logistics.

Introduction of a new course or the modification of existing courses to include risk would aid in reducing the inconsistencies found in various risk assessments at ASD. It would aid in defining a more concrete role for risk in the systems acquisition arena and in making risk assessments a more useful management tool in these times of high visibility programs having to deal with tight budgets, short suspenses, and highly complex technologies.

Recommendations for Further Study.

An expansion of this study to include program managers at other Air Force

Systems Command product divisions would help determine whether or not the introduction of a course on risk in the Air Force systems acquisition process would be beneficial. Also, a study of how senior Air Force officials view the concept of risk would be useful as a comparison to how the junior and mid-level acquisition managers view risk.

Further analysis of the relationships between technical degree holders and their risk taking tendencies could provide useful insight into being able to predict where the risk emphasis will likely be placed on a program. The analysis of the data showed that differences exist between technical and non-technical degree holding program managers. A slight bias toward risk taking by technical degreed managers was identified, and it may be that technical people do not care as much about cost or that non-technical people do not understand the technical risks as well as technical people. It is important to know why this difference occurred. The management of inherently risky programs will likely be affected by these biases if they are confirmed to exist by further study. Without a more in-depth understanding of this relationship, progress in managing program risk is not likely to occur.

Finally, a pre-test could be performed on students entering courses at AFIT or DSMC to evaluate their knowledge of risk and risk assessments. These results could be used to confirm the results of this preliminary study.

Summary

The risks associated with the procurement of Air Force weapon systems are real and plentiful. They are related to such problems as cost overruns, schedule slippages, and technical roadblocks. If these risks are investigated, identified, and properly managed, many of these problems can be avoided through diversion of resources and other means. In order to properly investigate, identify, and manage risk, program managers must be properly educated in the areas of risk assessment and analysis. The program managers in this study do not appear to be properly trained, and problems associated with improper management of risk could emerge. The introduction of some type of formalized education at the Air Force Institute of Technology in the areas of risk management, risk assessment, and risk analysis would be a wise move toward preventing problems relating to this lack of knowledge.

Appendix A: Interview Guide

Risk in Decision Making Interview Guide

Interview Control Number _____

Personal Data

Rank or Grade: _____

Age:
- ____ 21-25 yrs
- ____ 26-30 yrs
- ____ 31-35 yrs
- ____ 36-40 yrs
- ____ over 40 yrs

Marital Status:
- ____ Single
- ____ Married

Number of Children: _____

Sex: _____

Educational History:

Undergraduate Major Field(s) of Study/Degree, Year Completed: _____

Graduate Field(s) of Study/ Degree, Year Completed: _____

Air Force Institute of Technology Professional Continuing Education Courses: _____

Professional Military Education:

- ____ SOS Method: _____
- ____ ACSC (or equivalent) Method: _____
- ____ AWC (or equivalent) Method: _____

Work History:

Present:

Time Period: _____

Location: _____

Job Title: _____

Responsibilities: _____

_____

_____

_____

_____

_____

Previous:

Time Period: _____

Location: _____

Job Title: _____

Responsibilities: _____

_____

_____

_____

_____

_____

Previous:

Time Period: _____

Location: _____

Job Title: _____

Responsibilities: _____

_____

_____

_____

_____

_____

Previous:

Time Period: _____

Location: _____

Job Title: _____

Responsibilities: _____

_____

_____

_____

_____

Risk Definition:

1. How would you describe the concept of risk?

Risk in Decision Making:

2. Describe how you usually evaluate risk. What process or steps do you go through? Can you give an example?

3. Do you use any other methods to evaluate risk? If so, which ones?

_____

_____

_____

_____

_____

4. Where did you learn the methods described above?

_____

_____

_____

_____

_____

5. Are you familiar with any of the following quantitative risk assessment tools?

1. Expected Value/Utility Analysis _____
2. Network Analysis (PERT, VERT, CPM) _____
3. Decision Tree Analysis _____
4. Life Cycle Cost Models _____
5. Computer Simulation (SLAM, SIMPLE) _____

6. Have you been involved with a risk assessment in making decisions affecting any of the following areas?

1. Contractor Source Selection: _____
2. Preparing an Acquisition Strategy (Program Management Plan): _____
3. Preparing an Acquisition Plan risk assessment for the Procuring Contracting Officer: _____

4. Determining the type of contract to be used: _____

5. Determining Test & Evaluation objectives: _____

6. Other areas: _____

_____

_____

7. Please indicate in the matrix below what types of risk (cost, schedule, performance) were associated with each of the above program decision areas?

In the same boxes, please indicate the relative importance of each of these risk types using the scale below (1 through 5)?

Not at all Important	Little Importance	Somewhat Important	Very Important	Extremely Important
1	2	3	4	5

	Cost	Schedule	Tech Perf
Source Selection			
Acquisition Strategy (PMP)			
Acquisition Plan			
Contract Type			
T&E Objectives			
Other			

Comments: _____

_____

_____

_____

_____

8. If risk assessments were done in any of the above areas, what methods were used?

_____

_____

_____

_____

_____

_____

9. Generally, on a scale from 0 to 100, how thoroughly are risk assessments or analyses performed?

Min Max
0---10----20----30----40----50----60----70----80----90---100

10. What is the primary reason you perform risk assessments the way you do?

_____

_____

_____

_____

_____

11. How would you describe yourself as far as risk is concerned? Risk taker? Risk neutral? Risk avoiding? Why?

12. Are you comfortable with your knowledge of risk and risk assessments? If not, in which areas would you like to increase your knowledge?

13. Are you familiar with any DoD guidance on risk assessment, analysis, and management? If so, which guidance? Where would you like to see more guidance?

Appendix B: Interview Guide Responses

Question 1. How would you describe the concept of risk?

1. Risk is the likelihood of an unplanned event happening. The event has some sort of adverse effect. Risk is not necessarily quantifiable, and it is a broad (general) term.

2. Risk contains areas of design that are not understood or identified by both government and contractor. It causes schedule slips and cost overruns. Risk is involved with state-of-the-art versus known concepts and designs. Risk occurs when the time period allowed to perform the development is not realistic (too short).

3. Generally, risk is the level of uncertainty (number of uncertainties). It asks, "What are the unknowns?" On the job, risk is involved with high technology. The money involved is not really important. All aspects of risk seem to be interrelated (cost, schedule, and performance). It's a struggle to quantify risk. All aspects of risk should be tied together and not broken out separately because they all have effects on each other.

4. Risk is the degree at which you'll expect to accomplish something within constraints (money, time, resources, technology). Risk is derived from uncertainty.

In other words, any risk involves uncertainty. At work, the degree of consequence is the driver.

5. Risk is the probability that a program will fall into line. It's made up of cost, schedule and technical risks. Each has an influence on the others. Risk is what the individual or group arrives at. No specific definition exists (no standard rating system).

6. Risk is the chance of failure or loss associated with some action or decision. It's directly related with obtaining accurate information about an action or decision.

7. Risk is the term used to describe uncertainty. If one takes a risk, there is a chance that whatever is attempted may fail. This failure could result in loss of money or possibly injury/death to the one attempting the task. If one applies this concept to program management, then risk usually refers to the possibility of program failure. It's useful for upper management.

8. In reference to program management, risk is the probability of success vs failure of completing an entire project (and portions of that project) by meeting the requirements, schedule, costs, milestones, and goals of that project. It's the likelihood of accomplishing tasks given cost and time constraints, limitations of operations flexibility, or any other externally applied constraints that impact how or when management techniques are applied.

Legislated limitations and constraints drive time risks. For example, sole source limitations.

9. Risk is something that impacts the schedule. These may be assets, resources, or money. Consequences aren't the big concern; they can be dealt with more easily. (As opposed to the likelihood of an event occurring)

10. Risk is when you expose yourself to some type of danger. It relates to output vs input. Don't expend more time and effort than you'll recover. Risk is involved with new areas of development rather than with off-the-shelf hardware.

11. Risk is the state of balancing what can go right (reward) vs what can go wrong (price you pay). The level of risk depends on the severity of the consequence. Loss of life is a high risk situation.

12. The risk of a program depends on the technical aspects of the program, the dollars spent, and the schedule impacts of certain decisions. Risk is subjective. The user of the weapon system drives the requirements and the subsequent risks.

13. Risk is the probability that I will achieve a goal, given a number of paths to choose from to meet that goal. Factors in a risk assessment include schedule, budget, technology, and politics.

14. Risk is the probability of a mishap occurring.

15. The concept of risk is the taking of reasonable chances to achieve success in a given venture.

16. Risk is a measure of uncertainty applied to a certain situation. In the Air Force there are cost, schedule and technical risks.

17. Risk is a condition in which failure to address issues results in unacceptable consequences or programmatic concerns. It mainly deals with cost and schedule. Risk always exists. Risk is different from uncertainty in that risk is quantifiable and deals with probabilities while uncertainty does not.

18. Risk is the difference between the maximum amount a program could cost if all reasonably possible contingencies occur, and the minimum amount a program could "reasonably" cost if a contractor manages well, is innovative, and does proper planning. Technical and schedule risks evolve into cost risks.

19. Risk is the uncertainty induced by schedule or budget problems caused by unrealistic expectations. Risk arises when proposed schedules are unrealistic. Our risks are generally low because we don't really push the state-of-the-art.

20. Risk is the possibility of not reaching a goal technologically, managerially, or financially.

21. Risk occurs when you choose a course of action which allows the opportunity for failure.

22. Risk is a measure of the susceptibility to failure.

23. Risk is the probability of occurrence, given possible outcomes. Risk analysis involves defining the risk, consciously looking at it, and separating it from uncertainty.

24. Risk involves putting yourself in a position to where you are in a gambling situation. Factors include schedules and technology.

25. Risk is the impact of a decision to be made. In the Air Force, this involves schedule decisions, money decisions, and technical performance decisions. Risk assessment is a day-to-day iterative process.

Question 2. Describe how you usually evaluate risk. What process or steps do you go through? Can you give an example?

1. I don't use any quantitative method of evaluating risk. I use a subjective approach. The size of the program dictates the level of assessment. My program is a small program using lots of pre-developed items, i.e. no risk. Any assessments I do are informal, based on past experience.

2. First, I try to understand the design concepts and/or problems on a detailed level up front. Then I perform early simulations and studies to define the concept

and logic of the design, and I update these throughout the development to reflect the current design. I then get involved with the testing of the subsystem/system at the earlies point and continue through system maturity. Fi- ily, I'll perform an independent verification/validation of the design using consultants or Air Force experts. I feel that the ratings of "high," "low," and "moderate" are insufficient to adequately categorize risk. They are just too broad and vague.

3. First, what's the bottom line? What technologies am I dealing with, and what is the status of the effort? In evaluating risk, I rely primarily on prior experience, and my knowledge of the system. I also rely on expert experience for technical matters. General lessons learned are useless. Specific lessons learned are much more helpful. I usually end up telling people what they want to hear as far as low, moderate, or high risk is concerned. Political influences are very strong and can cause a legitimate risk assessment to be "thrown out the window" so that a more favorable "assessment" can be briefed up the management chain.

4. My risk assessments have no real pattern. I don't do any formal risk assessments. When I assess the risk of a situation I collect all the information I can and get a "gut feel" for the risk. I obtain that information by consulting experts in the particular fields and by calling on my own

experiences. I get a feel for risk by thinking through causes and effects.

5. I assess risk using a "gut feel" based primarily on past experience. I refine that assessment by using expert opinions. As far as cost risk is concerned, I address trade studies to see what I can get with a given budget. I then assess how acceptable that is. Generally, I'll look at risk up front in the program and then make spot checks through the life of the program. I do this because the risks of a program are highly variable.

6. In my job I evaluate risk mainly through a common sense approach. I simply weigh the pluses and minuses in my head. I don't really have a formalized process with steps that I go through.

7. Risk is evaluated in a subjective manner with certain objective inputs. For instance, when evaluating program risk, one must consider funding, schedule, complexity of tasks, new technology, and program personnel. Most of these can be measured objectively, but the combination of all of them is usually too complex to be able to measure with any certainty. A program pushing advanced technology and underfunded would appear to have a large degree of risk, yet with a technology breakthrough and congressional interest, the program could end up quite successful. Information is collected using contractor past

performance data and is gathered from experts on the government side.

8. First, you gather information: background, requirements from the user, tasks required, funding constraints/limitations, historical/past performance record, reliability/credibility, technological rating similar program precedence and performance, etc. Second, you assemble the information into a coherent structure: costs/schedule/problems/constraints/barriers. Then you define and evaluate the critical path to completion. You evaluate each subtask and barrier. You then estimate the probabilities for each successful subtask completion. Finally, you evaluate the overall probability for project completion.

9. I look at resources first (hardware, people, and money). Then I look at the near term situation and evaluate what possible impacts there are to the schedule. Schedule is the primary risk associated with a program because of user needs. We need to meet a specified Initial Operation Capability date. You may be forced to jeopardize technical performance to meet schedule requirements.

10. I develop alternatives to minimize risk. What's the backup plan? I usually use a gut feel for my risk assessments because of time considerations. I'll bounce questions off experts to avoid "making the same mistake twice."

11. I'll ask experts on what is good or what is bad with the program. I try to get several opinions and then make my own assessment based on all of the input.

12. Past history is very important. I'll look at my program's similarity to other programs. I gather information from the various project management teams and support people. I then pool the information gathered and make a recommendation of my own. Software is a big risk. It requires much more attention because of all of the unknowns associated with software development.

13. First, define your problem. How important is it for the "all around" program or the "big picture?" Second, we make a committee decision. I gather the experts together and we make a decision based on inputs from the functionals.

14. My risk assessments are based on prior experience. Precedence is the most important aspect. Working as a wing safety officer, we worried whether or not we were going to kill somebody, and we made risk assessments based on similar missions in the past. In the acquisition area I rate risks high, medium, and low. I rate something a high risk when I know "something will eat me up." I rate it medium when there is a 50-50 chance of something happening, and I rate something low risk if I feel there is an 80% probability that the program or decision will be a success.

15. I usually assess the situation by listing the pros and cons and then establishing the most likely alternative

for success (given a minimum of unknowns). It's a mental process that produces a gut feel based on past experience.

16. My risk assessments are based on intuition or gut feel. Historical programs help, and I'll talk to experts in any specific areas that I am not familiar with.

17. I don't use any quantitative methods for evaluating risk. My risk assessments are usually informal, based on personal experience. I'll tap into the laboratory for their opinions on highly technical areas of the program, and I'll use data from other programs to possibly learn from their mistakes. Our program attempts to minimize risk by conducting periodic design reviews and production readiness reviews.

18. We try to predict which events in the contractor's estimates are bound to occur. We try to separate out the events we are not so sure about occurring. This provides the basis for our low to high risk items, depending on how sure we feel about the probability of success. These predictions are based on input from the experts in the field: engineers, contracting officers, logisticians, etc.

19. My risk evaluation process is a data gathering process. I do some background research, and I'll talk to people who work in specific areas. My risk assessment is then based on my gut feel for the situation.

20. I'll evaluate the approach we're taking and use historical data. I'll also check with other people. It's

really usually an informal process and ends up being a gut feel based on experience.

21. First, look at what the issue is. Look at past performances. Ask, what's the consequence of the contractor not getting something right? What can be done to work around it? I'll rely on information furnished by the contractor, information provided by tech people and engineers, and information found in past performances. My risk assessments have all been informal risk assessments.

22. I evaluate risk based on past experience. Risk is evaluated by determining what the results of failure are. Management tools (schedules & budgets) are also widely used to evaluate risk. Again, evaluations are based on intuition and experience.

23. I have no "canned" process for evaluating risk. We usually evaluate risk with the "seat of our pants" approach. A weakness is that we don't always look at the threat and overall mission of the Air Force when evaluating risk. I will rate risk on a high/moderate/low scale which is subjective but based on experience and job expertise. The risk assessments are only as accurate as the information that is inputed.

24. It's an informal evaluation. I run through folks who've done the job before. I look at contractor experience. I go to technical experts for information. I also look at historical/previous work in the area.

Experience is very valuable. Because of the nature of my program, I haven't dealt with any high risk situations, and any risk assessments were strictly informal.

25. I rely on a team of functionals to provide me information on my risk assessments. I can't afford to get down into the nuts and bolts, so I rely heavily on my support people. Risk is a day-to-day thing, and the risk evaluation of any situation needs to be updated regularly. I make use out of historical data whenever it exists, but with many Air Force systems, a historical precedent is simply not there.

Question 3. Do you use any other methods to evaluate risk? If so, which ones?

1. Not really, it's mainly just a subjective evaluation.

2. I try to increase my own knowledge base all the time so that I can become more confident with the assessments I make.

3. I don't use any quantitative methods (number crunching). I look at contractor past performance and make use of scheduling tools.

4. I've used PERT charts for schedule risk evaluation, and that was very helpful. Unfortunately, we are often told

what the risk of the program will be by direction from superiors.

5. No.

6. No.

7. I have used the PERT networking technique.

8. My risk evaluation is dependent upon the type of project and program being run. Risk evaluation should be tailored to suit an individual program or project. Blending methods to suit a particular program is best. You need to know where you feel comfortable. This allows you to make a gut feel assessment of the risks involved.

9. PERT.

10. In the software area, I've used the COCOMO life cycle cost model.

11. I've used PERT charts and life cycle cost models. We used the life cycle cost models because it was required in the cost estimate.

12. No, not any others personally. I have seen use of life cycle cost models and extensive trade study analysis, but because of time constraints, I haven't used any in-depth analysis.

13. I haven't use any quantitative tools. I feel that a risk assessment is inherent in any decision. The size and seriousness of the issue will dictate how extensive the risk assessment is.

14. I've used MIL STD 882B, the System Safety Program Requirements regulation. This was for my time as wing safety officer.

15. No, I have not yet worked on a program that a major quantitative analysis had to be used. However, I would willingly employ such a tool when warranted.

16. No.

17. I've used contractor producibility trade studies, whereby design alternatives are weighed with respect to cost, technical feasibility, and risk.

18. No.

19. We use CSNAS (Computer Supported Network Analysis System) to do a PERT analysis and identify critical paths in our manufacturing plan. We also use independent review teams to review our program and determine their own risk assessment.

20. I've used Milestone and Gantt charts.

21. Not personally. I've heard about the DSMC risk model for quantitative risk analysis, but for our purposes, the utility would be quite low.

22. No.

23. No.

24. No.

25. I use common sense. Sometimes I'll look at the historical background of a program where lessons learned can be helpful. I'll also tap into the bosses power to reduce

the risks of my program (additional funds, slipped schedule requirements, etc.). Risks may be driven down because of vested political interests from above.

Question 4. Where did you learn the methods described above?

1. Personal experience and common sense.
2. From experience, my own and others.
3. Experience.
4. On the job experience. I learned PERT at school and in my PCE courses.
5. On the job trial and error. Informal training from people in the program office. Operational experience has helped in some areas.
6. N/A
7. I learned PERT in a PCE short course and in my masters courses.
8. Some of it came from management education, some from trial and error, some is just common sense. Some came from experienced individuals, and some came from my own experiences.
9. From my contractor and Systems 200 course at AFIT.
10. At school and at work.
11. From the contractor and from work.

12. On the job is where you learn. Experts let you know what you do in areas unfamiliar to you.

13. N/A

14. The System Safety Officer course at Norton AFB and my own prior experience.

15. N/A

16. N/A

17. Schooling, experience, and technical publications.

18. Contracting courses, the FAR.

19. For CSNAS, I attended an AFALC ccurse.

20. Experience.

21. In the SPO (program office).

22. By living it.

23. Job experience.

24. No formal training, mainly experience driven.

25. On the job experience.

Question 10. What is the primary reason you perform risk assessments the way you do?

1. Time restrictions is the primary reason. Because of the nature of the program I work on, everything being off-the-shelf, there is very little risk involved.

2. You need to be active in the design process and get involved. Addressing risk early in the program is most important.

3. Because of tasking. Risk assessments are political if they are required. They are reactionary and done only after-the-fact (after a problem has emerged). The level of the risk assessment is usually pre-determined. Generally, risk assessments are not used for managing programs.

4. Because of time constraints. Also resource constraints drive what type of risk assessment is performed.

5. It's what I'm comfortable with, and it's worked so far.

6. I haven't been introduced to any formal techniques, and I don't have the database to perform the ones I know.

7. Because of experience. Number crunching is not as effective.

8. Because of limited resources and competition for funds. I'm skeptical about some contractors. I don't want to get burned.

9. Because the tools are not available and the information is needed yesterday.

10. To reach the best possible/cost effective/optimum solution to a problem.

11. Because of time. What is the quickest way?

12. Cost is the big driver. I need the best way at the least cost.

13. Because it's the way I've learned and it's worked given the importance and time available, but political drivers do exist.

14. I do risk assessments the way I do them to help me direct resources (High risk requires more resources).

15. I have become very comfortable with my personal rule of thumb of risk taking/assessments. This is based strictly on experiences gained through the years rather than structured detailed procedure.

16. Because of time constraints. Because of lack of knowledge of other methods. Also, "The colonel will end up putting what he wants."

17. It's whatever comes naturally. Risk assessment is inherent in the pragmatic program management process.

18. We will do a thorough risk assessment but we won't use it.

19. It's the only way I know how.

20. I do them for peace of mind. Time is a driver.

21. I do them to answer questions I have about schedule, cost, and performance.

22. Speed. It may be less accurate, but it's quick. Accuracy isn't required in most cases. The exception is in source selection.

23. Because of lack of time and information. Possibly because of a lack of proper tools.

24. It's an effective way of doing it, schedule being the driver.

25. We do them to satisfy user needs with schedule being our big driver.

Question 11. How would you describe yourself as far as risk is concerned? Risk taker? Risk neutral? Risk avoiding? Why?

1. Risk taker. I feel that I have good enough judgment. I avoid bad risks, i.e. low probabilities of occurrence.

2. Based on past failures, I'm risk avoiding. At work, we're forced to take the low risk approach.

3. I lean toward being risk avoiding. I value my own security. I'll take more risks at work than with my personal life.

4. Personally, risk taker. You need to take risk to get anywhere. On the job, risk neutral because of the environment.

5. Depends on the type of risk. Avoid high cost risk. Schedule risk depends on the urgency of need. For technical risk, what can the user live with?

6. Risk taker. Because it's better to progress than to hold off just to avoid a bad decision. Mistakes are learning experiences. I have no real fear of the political repercussions.

7. Risk taker. I don't feel any pressure to be anything less. If they don't like me, I'll go back to flying.

8. Personal risk - risk taker. These are known quantities. Professionally - risk averse. I'm dealing with government money. I can't gamble with what doesn't belong to me. Uncertainties are what's feared. Known risks are acceptable.

9. Risk taker. If you don't try something new, how will you ever know the right way of doing anything or whether you made the right decision. You know things can be accomplished the way they've been done before, but is the old method efficient? Can you save time, money or performance by altering the status quo?

10. I'm a risk taker to make a project move that needs moving. I'm risk averse when the expected outcome is less than the input.

11. Usually risk avoiding. If you screw up, you look and feel bad. People remember your screw up. It really depends on the payoff. I'll take a risk with a big program if the payoffs are worthy.

12. It's situational. I take risks when the need is urgent.

13. Personally, not a risk taker. Professionally, you need to take risks. You have to take risks to get things done. It's very much a function of the environment.

14. Risk taker. You do it yourself, you get things done. While flying, I'm more conservative. I need to know all information.

15. Risk taker. This is based on working in the electronic warfare SPO between 1964 and 1979.

16. Risk neutral. Because I like positive outcomes. Then it doesn't hurt as bad if something doesn't work.

17. Risk taker. I pretend to be, but I'm probably not as much as I think I am.

18. Risk avoiding. With limited resources, I'd rather spend the taxpayer's money on a sure thing before I spend it on a very risky deal. Pilots are high risk takers by the nature of their business. By using pilots in program management positions we tend to buy risk before a sure thing.

19. Lean toward risk taker. I'm usually optimistic about schedules, etc.

20. Risk taker. You get benefits from building and fixing rather than "studying it to death."

21. Risk taker. I fly and jump out of airplanes. I would tend to take more personal risk than risking the government.

22. I will take on a risk, then try to minimize or reduce the chances of failure.

23. I lean slightly toward risk taker. You have to make decisions without perfect information. You can't wait on others to make decisions for you.

24. Slightly risk taking. You press ahead because it's necessary. I don't put myself or my program in

jeopardy. There are times when you have to stick your neck out.

25. Somewhere slightly risk taking. Nothing ventured, nothing gained. Success is based on how often that works as a philosophy.

Question 12. Are you comfortable with your knowledge of risk and risk assessments? If not, in which areas would you like to increase your knowledge?

1. No. I'd to learn more about formal risk assessments and some quantitative methods.

2. No. I need to improve my knowledge of risk indicators. I need to know how to avoid risk and how to stop it. Tools are good only if they reflect reality.

3. Yes. Because of experience. I would like to know more about tools to be smart on other people's assessments.

4. No. More familiarity and experience is necessary.

5. No trouble as long as a logical path is laid out and risk is communicated well. Since inputs to quantitative tools are not common, their usefulness is not really clear. Information being good is critical.

6. No. I'd like to learn more about the application of formal processes to p. ject management.

7. No. Would like to know more about quantitative methods. The computer can back you up. Tools give meat behind a subjective assessment.

8. No. You can't ever know all there is, but you may want to know more. The more you know, the better off you are. Until there is a big risk you may not need any additional knowledge. Several methods for doing a risk assessment may be more useful.

9. Not necessarily comfortable with my gut feel decisions. More information may be useful. Tech experts are not always easy to find, and tools are not always accessible.

10. No. I'd like to be more familiar with some of the quantitative tools to utilize for risk assessment.

11. Don't know. I don't have enough knowledge to really answer the question. I've had no formal instruction on how to do a risk assessment.

12. Yes. I'm as knowledgeable as I have time to be. I rely on my functionals. I make a subjective assessment of risk from the functional inputs.

13. Yes. You learn by doing mostly. I may like to see some management schooling in this area, though.

14. No, not in the acquisition environment. I'm just too unaware of the outside forces.

15. I'm comfortable with the programs I've worked so far. I would like to increase my knowledge in the decision

tree analysis.

16. No. Some more knowledge of some of the quantitative tools would be useful.

17. I'm comfortable for the most part. Don't feel so much like I need an increase in knowledge, but to more effectively implement some of the more quantitative, scientific techniques as discussed.

18. Technical risk is tough for me. We depend on technical evaluations from out engineers who are often too busy to support all our efforts.

19. No. I could use more experience.

20. So far, what I know has been adequate. There are some weaknesses, and some increased knowledge may be beneficial.

21. Yes. For my purposes, I'm comfortable. If the situation changed, possibly not.

22. No. I want to get away from the gut feel, or at least have another measure to compare.

23. Yes, but not totally comfortable. The more you know, the more you don't know.

24. Yes. It's sufficient for the moment, but that could change with a more complex program.

25. Yes, for the level I am at, but that may change later.

Question 13. Are you familiar with any DoD guidance on risk assessment, analysis, or management? If so, which guidance? Where would you like to see more guidance?

1. No.

2. Yes, I'm familiar with a manual on software risk assessment. It's too vague. It shows how to identify risk indicators but gives no solutions.

3. No. Risk assessment guides would be useful.

4. I'm familiar with risk assessment templates, but generally they're not useful. I would find an informal process more effective and efficient.

5. No. A risk assessment guide would be useful for further questions if available.

6. No.

7. No. It would be nice for PCE courses to cover risk assessment.

8. No.

9. Other than what I learned in SYS 200, no. I would like to see more guidance. I don't want to be like some supervisors I've known who are afraid to make decisions because they don't have the means of interpreting the data they have. A course at AFIT may be useful. Decisions don't seem to be made, and the ability to assess risk would help make decisions.

10. No. A reference manual would be useful, and a course would be useful.

11. No. It would be helpful to know how to get guidance. Risk assessment techniques could be an addition to a systems acquisition course.

12. No. What is known is learned on the job. You need to trust the SPO people's knowledge. Short courses would be useful to increase people's ability to perform assessments.

13. No.

14. MIL STD 882B. Risk should be introduced to coursework.

15. No.

16. No.

17. I'm aware that they exist, but I cannot cite the regulations or guidance. I'm aware of the Willoughby Templates for identifying risk areas.

18. AFSCR 70-15, Federal Acquisition Regulation.

19. No. Could use it in acquisition classes.

20. No. Could use some material for reference. Would be useful to add into an acquisition class.

21. DSMC cost models, Willoughby Templates.

22. No. Guidance would be useful in an acquisition class.

23. Yes.

24. Yes. The tech library has lots of info. A macro introduction into risk assessment would be useful so that program managers would know where to look for information when they needed it.

25. No. A top level school that doesn't necessarily get into the specifics would be useful.

Appendix C: Question 7 Data

STORM DATA SET LISTING
DETAILED PROBLEM DATA LISTING FOR
COST RISK RELATIVE IMPORTANCE

ROW LABEL	SOURCE SEL	ACQ STRAT	ACQ PLAN	CONTRACT	T&E
CASE 1	2.	4.	4.	3.	2.
CASE 2	4.	3.	3.	4.	3.
CASE 3	.	5.	.	5.	3.
CASE 4	5.	4.	5.	4.	3.
CASE 5	4.	5.	5.	4.	4.
CASE 6	4.	3.	3.	4.	3.
CASE 7	4.	3.	4.	5.	4.
CASE 8	4.	4.	5.	5.	4.
CASE 9	5.	3.	4.	4.	2.
CASE 10	4.	3.	5.	4.	3.
CASE 11	3.	5.	5.	5.	3.
CASE 12	3.	2.	4.	.	3.
CASE 13	.	3.	5.	5.	4.
CASE 14	4.	4.	4.	5.	2.
CASE 15	5.	4.	4.	5.	3.
CASE 16	5.	3.	3.	4.	4.
CASE 17	4.	3.	5.	5.	3.
CASE 18	.	5.	5.	5.	.
CASE 19	4.	4.	2.	4.	2.
CASE 20	3.	4.	4.	4.	.
CASE 21	4.	5.	5.	5.	4.
CASE 22	5.	3.	3.	4.	3.
CASE 23	4.	3.	3.	4.	2.
CASE 24	4.	3.	3.	5.	3.
CASE 25	4.	3.	3.	4.	3.

STORM DATA SET LISTING
DETAILED PROBLEM DATA LISTING FOR
SCHEDULE RISK RELATIVE IMPORTANCE

ROW LABEL	SOURCE SEL	ACQ STRAT	ACQ PLAN	CONTRACT	T&E
CASE 1	3.	5.	4.	1.	4.
CASE 2	3.	3.	3.	4.	4.
CASE 3	.	4.	.	3.	5.
CASE 4	4.	5.	5.	5.	2.
CASE 5	4.	5.	5.	4.	4.
CASE 6	4.	4.	3.	2.	3.
CASE 7	3.	4.	4.	3.	4.
CASE 8	2.	4.	5.	4.	3.
CASE 9	2.	4.	4.	3.	3.
CASE 10	5.	5.	5.	3.	4.
CASE 11	4.	5.	5.	3.	4.
CASE 12	3.	4.	3.	4.	4.
CASE 13	.	3.	3.	4.	4.
CASE 14	3.	3.	4.	3.	3.
CASE 15	5.	4.	4.	4.	4.
CASE 16	5.	4.	4.	4.	4.
CASE 17	3.	4.	4.	3.	4.
CASE 18	.	5.	5.	3.	.
CASE 19	4.	4.	5.	4.	4.
CASE 20	3.	4.	4.	3.	.
CASE 21	4.	4.	4.	5.	4.
CASE 22	5.	3.	4.	4.	3.
CASE 23	4.	3.	3.	4.	3.
CASE 24	4.	4.	4.	3.	5.
CASE 25	4.	4.	4.	3.	4.

STORM DATA SET LISTING
DETAILED PROBLEM DATA LISTING FOR
TECHNICAL RISK RELATIVE IMPORTANCE

ROW LABEL	SOURCE SEL	ACQ STRAT	ACQ PLAN	CONTRACT	T&E
CASE 1	5.	5.	1.	5.	5.
CASE 2	5.	3.	3.	3.	5.
CASE 3	.	5.	.	4.	4.
CASE 4	4.	3.	5.	3.	5.
CASE 5	5.	4.	4.	5.	5.
CASE 6	4.	4.	3.	.	4.
CASE 7	5.	4.	4.	3.	5.
CASE 8	4.	5.	5.	5.	5.
CASE 9	4.	3.	3.	4.	5.
CASE 10	5.	4.	5.	3.	5.
CASE 11	5.	4.	4.	2.5	5.
CASE 12	4.	3.	3.	.	5.
CASE 13	.	3.	3.	4.	4.
CASE 14	4.	5.	4.	3.	5.
CASE 15	5.	4.	4.	3.	5.
CASE 16	5.	5.	5.	4.	5.
CASE 17	4.	3.	4.	4.	4.
CASE 18	.	5.	5.	3.	.
CASE 19	3.	3.	4.	5.	4.
CASE 20	5.	4.	4.	4.	.
CASE 21	4.	3.	3.	4.	5.
CASE 22	4.	4.	4.	3.	5.
CASE 23	5.	3.	3.	2.	3.
CASE 24	5.	4.	4.	4.	4.
CASE 25	4.	3.	2.	2.	3.

COST RISK RELATIVE IMPORTANCE
MEANS, VARIANCES, AND OTHER STATISTICS

	SOURCE SEL	ACQ STRAT	ACQ PLAN	CONTRACT
No. of cases :	22	25	24	24
Average :	4.0000	3.6400	4.0000	4.4167
Standard dev :	0.7559	0.8602	0.9325	0.5836
Skewness :	-0.7276	0.3804	-0.3510	-0.3646
Kurtosis :	1.1789	-0.8278	-1.0455	-0.6783
PERCENTILES :				
0th (Minimum) :	2.0000	2.0000	2.0000	3.0000
5th :	2.1500	2.3000	2.2500	3.2500
25th (Lower) :	4.0000	3.0000	3.0000	4.0000
50th (Median) :	4.0000	3.0000	4.0000	4.0000
75th (Upper) :	4.2500	4.0000	5.0000	5.0000
95th :	5.0000	5.0000	5.0000	5.0000
100th (Max) :	5.0000	5.0000	5.0000	5.0000

	T&E
No. of cases :	23
Average :	3.0435
Standard dev :	0.7057
Skewness :	-0.0611
Kurtosis :	-0.8196
PERCENTILES :	
0th (Minimum) :	2.0000
5th :	2.0000
25th (Lower) :	3.0000
50th (Median) :	3.0000
75th (Upper) :	4.0000
95th :	4.0000
100th (Max) :	4.0000

SCHEDULE RISK RELATIVE IMPORTANCE
MEANS, VARIANCES, AND OTHER STATISTICS

	SOURCE SEL	ACQ STRAT	ACQ PLAN	CONTRACT
No. of cases	22	25	24	25
Average	3.6818	4.0400	4.0833	3.4400
Standard dev	0.8937	0.6758	0.7173	0.8699
Skewness	-0.1674	-0.0465	-0.1250	-0.6262
Kurtosis	-0.5311	-0.6058	-0.9116	1.5384
PERCENTILES :				
0th (Minimum)	2.0000	3.0000	3.0000	1.0000
5th	2.0000	3.0000	3.0000	1.3000
25th (Lower)	3.0000	4.0000	4.0000	3.0000
50th (Median)	4.0000	4.0000	4.0000	3.0000
75th (Upper)	4.0000	4.5000	5.0000	4.0000
95th	5.0000	5.0000	5.0000	5.0000
100th (Max)	5.0000	5.0000	5.0000	5.0000

	T&E
No. of cases	23
Average	3.7391
Standard dev	0.6887
Skewness	-0.5220
Kurtosis	0.8072
PERCENTILES :	
0th (Minimum)	2.0000
5th	2.2000
25th (Lower)	3.0000
50th (Median)	4.0000
75th (Upper)	4.0000
95th	5.0000
100th (Max)	5.0000

TECHNICAL RISK RELATIVE IMPORTANCE
MEANS, VARIANCES, AND OTHER STATISTICS

	SOURCE SEL	ACQ STRAT	ACQ PLAN	CONTRACT
No. of cases :	22	25	24	23
Average :	4.4545	3.8400	3.7083	3.5870
Standard dev :	0.5958	0.8000	0.9991	0.9127
Skewness :	-0.5526	0.3074	-0.7760	0.0625
Kurtosis :	-0.5244	-1.3440	0.9893	-0.7701
PERCENTILES :				
0th (Minimum) :	3.0000	3.0000	1.0000	2.0000
5th :	3.1500	3.0000	1.2500	2.0000
25th (Lower) :	4.0000	3.0000	3.0000	3.0000
50th (Median) :	4.5000	4.0000	4.0000	4.0000
75th (Upper) :	5.0000	4.5000	4.0000	4.0000
95th :	5.0000	5.0000	5.0000	5.0000
100th (Max) :	5.0000	5.0000	5.0000	5.0000

	T&E
No. of cases :	23
Average :	4.5652
Standard dev :	0.6624
Skewness :	-1.2882
Kurtosis :	0.6248
PERCENTILES :	
0th (Minimum) :	3.0000
5th :	3.0000
25th (Lower) :	4.0000
50th (Median) :	5.0000
75th (Upper) :	5.0000
95th :	5.0000
100th (Max) :	5.0000

STORM DATA SET LISTING
DETAILED PROBLEM DATA LISTING FOR
PERSONAL DATA INDICATOR VARIABLES

ROW LABEL	DEGREE	OPS EXPER	OTHER BASE	AGE>30	MARRIED	RISK TAKER
CASE 1	1.	0.	0.	0.	0.	1.
CASE 2	1.	0.	0.	0.	1.	0.
CASE 3	1.	0.	0.	0.	1.	0.
CASE 4	1.	0.	0.	0.	0.	0.
CASE 5	0.	1.	1.	1.	1.	0.
CASE 6	1.	0.	0.	0.	0.	1.
CASE 7	0.	1.	1.	1.	1.	1.
CASE 8	1.	1.	1.	1.	1.	0.
CASE 9	1.	0.	0.	0.	1.	1.
CASE 10	1.	0.	0.	1.	1.	0.
CASE 11	1.	0.	0.	0.	0.	0.
CASE 12	1.	1.	1.	1.	1.	1.
CASE 13	1.	0.	0.	1.	1.	1.
CASE 14	1.	0.	1.	1.	1.	1.
CASE 15	1.	0.	1.	1.	1.	1.
CASE 16	0.	0.	0.	0.	1.	0.
CASE 17	1.	0.	1.	0.	0.	1.
CASE 18	0.	0.	0.	1.	1.	0.
CASE 19	1.	0.	0.	0.	0.	1.
CASE 20	1.	0.	0.	0.	1.	1.
CASE 21	1.	0.	0.	0.	0.	1.
CASE 22	1.	0.	0.	0.	1.	1.
CASE 23	1.	0.	1.	0.	0.	1.
CASE 24	0.	0.	0.	1.	1.	1.
CASE 25	1.	1.	1.	1.	1.	1.

Note: A "1" indicates a "yes" response.

Appendix D: Risk Taker Correlation Matrix

RISK DESCRIPTION CORRELATIONS
CORRELATION (SAMPLE SIZE) MATRIX

	----DEGREE----	---OPS EXPER--	--OTHER BASE--
DEGREE	1.000(25)	-0.250(25)	-0.042(25)
OPS EXPER	-0.250(25)	1.000(25)	0.667(25)
OTHER BASE	-0.042(25)	0.667(25)	1.000(25)
AGE > 30	-0.363(25)	0.564(25)	0.510(25)
MARRIED	-0.343(25)	0.343(25)	0.157(25)
RISK TAKER	0.250(25)	-0.042(25)	0.215(25)

	---AGE > 30---	----MARRIED---	--RISK TAKER--
DEGREE	-0.363(25)	-0.343(25)	0.250(25)
OPS EXPER	0.564(25)	0.343(25)	-0.042(25)
OTHER BASE	0.510(25)	0.157(25)	0.215(25)
AGE > 30	1.000(25)	0.608(25)	-0.006(25)
MARRIED	0.608(25)	1.000(25)	-0.157(25)
RISK TAKER	-0.006(25)	-0.157(25)	1.000(25)

Appendix E: Question 7 Correlation Matrices

COST RISK RELATIVE IMPORTANCE CORRELATION (SAMPLE SIZE) MATRIX

	--SOURCE SEL--	---ACQ STRAT--	---ACQ PLAN---
SOURCE SEL	1.000(22)	-0.157(22)	-0.137(22)
ACQ STRAT	-0.157(22)	1.000(25)	0.450(24)
ACQ PLAN	-0.137(22)	0.450(24)	1.000(24)
CONTRACT	0.195(21)	0.269(24)	0.409(23)
T&E	0.191(21)	0.110(23)	0.420(22)
DEGREE	-0.160(22)	-0.095(25)	0.000(24)
OPS EXPER	-0.147(22)	-0.142(25)	0.112(24)
OTHER BASE	0.000(22)	-0.174(25)	0.094(24)
AGE > 30	0.000(22)	-0.099(25)	0.275(24)
MARRIED	0.256(22)	-0.191(25)	0.000(24)

	---CONTRACT---	------T&E-----	----DEGREE----
SOURCE SEL	0.195(21)	0.191(21)	-0.160(22)
ACQ STRAT	0.269(24)	0.110(23)	-0.095(25)
ACQ PLAN	0.409(23)	0.420(22)	0.000(24)
CONTRACT	1.000(24)	0.401(22)	-0.165(24)
T&E	0.401(22)	1.000(23)	-0.470(23)
DEGREE	-0.165(24)	* -0.470(23)	1.000(25)
OPS EXPER	0.065(24)	* 0.425(23)	-0.250(25)
OTHER BASE	0.258(24)	0.079(23)	-0.042(25)
AGE > 30	* 0.419(24)	0.326(23)	-0.363(25)
MARRIED	0.206(24)	0.311(23)	-0.343(25)

	---OPS EXPER--	--OTHER BASE--	---AGE > 30---
SOURCE SEL	-0.147(22)	0.000(22)	0.000(22)
ACQ STRAT	-0.142(25)	-0.174(25)	-0.099(25)
ACQ PLAN	0.112(24)	0.094(24)	0.275(24)
CONTRACT	0.065(24)	0.258(24)	0.419(24)
T&E	0.425(23)	0.079(23)	0.326(23)
DEGREE	-0.250(25)	-0.042(25)	-0.363(25)
OPS EXPER	1.000(25)	0.667(25)	0.564(25)
OTHER BASE	0.667(25)	1.000(25)	0.510(25)
AGE > 30	0.564(25)	0.510(25)	1.000(25)
MARRIED	0.343(25)	0.157(25)	0.608(25)

	----MARRIED---
SOURCE SEL	0.256(22)
ACQ STRAT	-0.191(25)
ACQ PLAN	0.000(24)
CONTRACT	0.206(24)
T&E	0.311(23)
DEGREE	-0.343(25)
OPS EXPER	0.343(25)
OTHER BASE	0.157(25)
AGE > 30	0.608(25)
MARRIED	1.000(25)

SCHEDULE RISK RELATIVE IMPORTANCE
CORRELATION (SAMPLE SIZE) MATRIX

	--SOURCE SEL--	---ACQ STRAT--	---ACQ PLAN---
SOURCE SEL	1.000(22)	0.108(22)	0.128(22)
ACQ STRAT	0.108(22)	1.000(25)	0.695(24)
ACQ PLAN	0.128(22)	0.695(24)	1.000(24)
CONTRACT	0.244(22)	-0.244(25)	0.074(24)
T&E	0.168(21)	0.098(23)	-0.070(22)
DEGREE	-0.172(22)	-0.272(25)	-0.231(24)
OPS EXPER	-0.299(22)	0.121(25)	0.085(24)
OTHER BASE	-0.226(22)	-0.171(25)	-0.092(24)
AGE > 30	-0.014(22)	0.068(25)	0.129(24)
MARRIED	-0.059(22)	-0.218(25)	-0.042(24)

	---CONTRACT---	------T&E-----	----DEGREE----
SOURCE SEL	0.244(22)	0.168(21)	-0.172(22)
ACQ STRAT	-0.244(25)	0.098(23)	-0.272(25)
ACQ PLAN	0.074(24)	-0.070(22)	-0.231(24)
CONTRACT	1.000(25)	-0.230(23)	0.023(25)
T&E	-0.230(23)	1.000(23)	-0.348(23)
DEGREE	0.023(25)	-0.348(23)	1.000(25)
OPS EXPER	0.094(25)	0.048(23)	-0.250(25)
OTHER BASE	0.102(25)	-0.086(23)	-0.042(25)
AGE > 30	0.015(25)	0.209(23)	-0.365(25)
MARRIED	0.052(25)	0.259(23)	-0.343(25)

	---OPS EXPER--	--OTHER BASE--	---AGE > 30---
SOURCE SEL	-0.299(22)	-0.226(22)	-0.014(22)
ACQ STRAT	0.121(25)	-0.171(25)	0.068(25)
ACQ PLAN	0.085(24)	-0.092(24)	0.129(24)
CONTRACT	0.094(25)	0.102(25)	0.015(25)
T&E	0.048(23)	-0.086(23)	0.209(23)
DEGREE	-0.250(25)	-0.042(25)	-0.363(25)
OPS EXPER	1.000(25)	0.667(25)	0.564(25)
OTHER BASE	0.667(25)	1.000(25)	0.510(25)
AGE > 30	0.564(25)	0.510(25)	1.000(25)
MARRIED	0.343(25)	0.157(25)	0.608(25)

	----MARRIED---
SOURCE SEL	-0.059(22)
ACQ STRAT	-0.218(25)
ACQ PLAN	-0.042(24)
CONTRACT	0.052(25)
T&E	0.259(23)
DEGREE	-0.343(25)
OPS EXPER	0.343(25)
OTHER BASE	0.157(25)
AGE > 30	0.608(25)
MARRIED	1.000(25)

TECHNICAL RISK RELATIVE IMPORTANCE
CORRELATION (SAMPLE SIZE) MATRIX

	--SOURCE SEL--	---ACQ STRAT--	---ACQ PLAN---
SOURCE SEL	1.000(22)	0.348(22)	0.015(22)
ACQ STRAT	0.348(22)	1.000(25)	0.310(24)
ACQ PLAN	0.015(22)	0.310(24)	1.000(24)
CONTRACT	-0.202(20)	0.230(23)	-0.007(22)
T&E	0.179(21)	0.330(23)	0.337(22)
DEGREE *	-0.442(22)	-0.357(25)	-0.363(24)
OPS EXPER	-0.051(22)	-0.026(25)	-0.057(24)
OTHER BASE	-0.014(22)	-0.060(25)	-0.033(24)
AGE > 30	0.144(22)	0.181(25)	0.189(24)
MARRIED	0.266(22)	0.298(25)	0.241(24)

	---CONTRACT---	------T&E-----	----DEGREE----
SOURCE SEL	-0.202(20)	0.179(21)	-0.442(22)
ACQ STRAT	0.230(23)	0.330(23)	-0.357(25)
ACQ PLAN	-0.007(22)	0.337(22)	-0.363(24)
CONTRACT	1.000(23)	0.263(21)	-0.126(23)
T&E	0.263(21)	1.000(23)	-0.131(23)
DEGREE	-0.126(23)	-0.131(23)	1.000(25)
OPS EXPER	0.084(23)	0.028(23)	-0.250(25)
OTHER BASE	-0.173(23)	-0.149(23)	-0.042(25)
AGE > 30	-0.085(23)	0.047(23)	-0.363(25)
MARRIED	-0.041(23)	0.214(23)	-0.343(25)

	---OPS EXPER--	--OTHER BASE--	---AGE > 30---
SOURCE SEL	-0.051(22)	-0.014(22)	0.144(22)
ACQ STRAT	-0.026(25)	-0.060(25)	0.181(25)
ACQ PLAN	-0.057(24)	-0.033(24)	0.189(24)
CONTRACT	0.084(23)	-0.173(23)	-0.085(23)
T&E	0.028(23)	-0.149(23)	0.047(23)
DEGREE	-0.250(25)	-0.042(25)	-0.363(25)
OPS EXPER	1.000(25)	0.667(25)	0.564(25)
OTHER BASE	0.667(25)	1.000(25)	0.510(25)
AGE > 30	0.564(25)	0.510(25)	1.000(25)
MARRIED	0.343(25)	0.157(25)	0.608(25)

	----MARRIED---
SOURCE SEL	0.266(22)
ACQ STRAT	0.298(25)
ACQ PLAN	0.241(24)
CONTRACT	-0.041(23)
T&E	0.214(23)
DEGREE	-0.343(25)
OPS EXPER	0.343(25)
OTHER BASE	0.157(25)
AGE > 30	0.608(25)
MARRIED	1.000(25)

Appendix F: Question 9 Data

STORM DATA SET LISTING
DETAILED PROBLEM DATA LISTING FOR
RISK ANALYSIS/ASSESSMENT THOROUGHNESS

ROW LABEL	X1
CASE 1	50.
CASE 2	65.
CASE 3	60.
CASE 4	40.
CASE 5	70.
CASE 6	70.
CASE 7	50.
CASE 8	50.
CASE 9	60.
CASE 10	60.
CASE 11	35.
CASE 12	50.
CASE 13	85.
CASE 14	35.
CASE 15	65.
CASE 16	30.
CASE 17	40.
CASE 18	50.
CASE 19	35.
CASE 20	40.
CASE 21	50.
CASE 22	55.
CASE 23	10.
CASE 24	45.
CASE 25	70.

RISK ANALYSIS/ASSESSMENT THOROUGHNESS
MEANS, VARIANCES, AND OTHER STATISTICS

	X1
No. of cases selected:	25
Average :	50.8000
Standard deviation :	16.0520
Skewness :	-0.2557
Kurtosis :	0.6691
PERCENTILES :	
0th (Minimum) :	10.0000
5th :	16.0000
25th (Lower Quartile):	40.0000
50th (Median) :	50.0000
75th (Upper Quartile):	62.5000
95th :	80.5000
100th (Maximum) :	85.0000

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Block 19

Abstract

The objective of this study was to determine how and to what degree Air Force program managers evaluated the risks associated with the various program decisions in which risk assessments are mandated by federal and defense regulations or directives.

This preliminary study took responses from a series of interviews with program managers to assess the program managers' knowledge of risk and risk assessments, how they usually performed risk assessments, why they performed risk assessments, and if any relationships existed between individual backgrounds and risk taking behaviors.

The research found that although the program managers in this study were all involved with risk assessments and analyses, they did not appear to be properly educated in the areas of risk and risk assessment. The managers were, however, interested in learning more about the concept of risk and strongly suggested the addition of formal coursework in the area of risk management.

This study also showed that differences are likely to exist between program managers possessing technical degrees (engineering, basic sciences, etc.) and those not possessing technical degrees with respect to how cost and technical risk are evaluated in various program phases. To get a more in-depth understanding of the relationship of risk to Air Force weapon systems acquisition, it is important to understand why these differences exist.

Consequently, it is recommended that further research be carried out to more precisely measure this difference in risk taking tendencies.